

The Tool Engineer

.....

RESISTANCE WELDING METHODS . . . P. 67

PUBLICATION OF THE AMERICAN SOCIETY OF TOOL  ENGINEERS

MARCH, 1951

VOLUME XVI, NO. 3

PLANNING
ENGINEERING OF TOOLING
EQUIPMENT



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The Tool Engineer

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AMERICAN SOCIETY OF TOOL ENGINEERS

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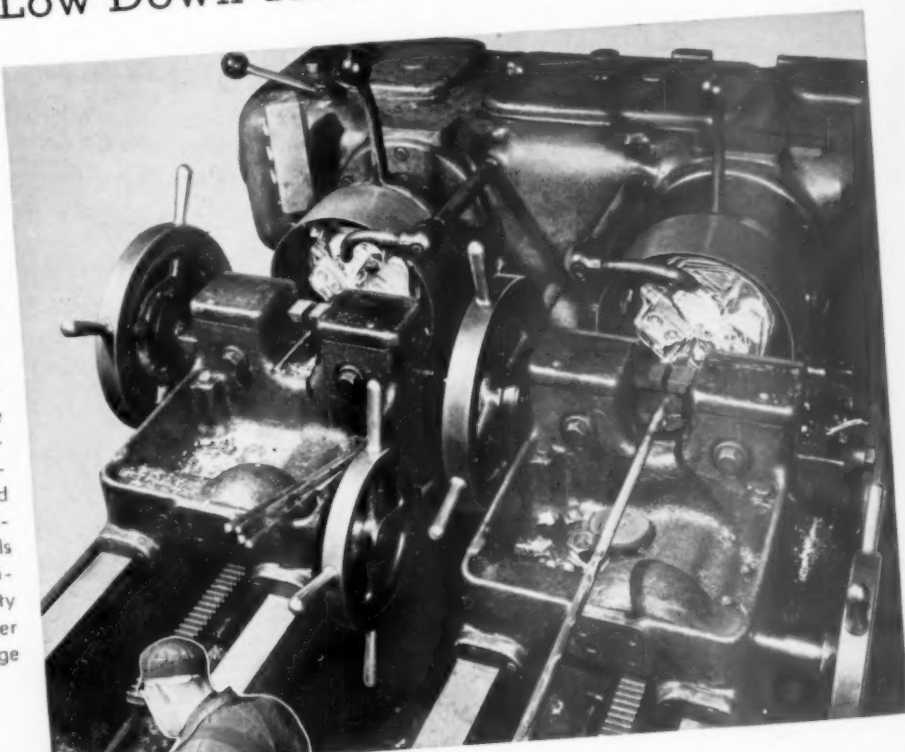


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This 1" Landmaco Double Machine is threading $\frac{3}{8}$ " and $\frac{1}{2}$ " cold drawn steel rods for structural and ornamental steel. The 13 and 16 pitch USS threads are cut 6" long, but on similar jobs threads are cut up to 20-foot lengths. Production costs are lower than with previous methods. This installation is an example of the value of Landmaco Double Machines in job threading work. Threads can be cut to Class 4 fit, yet work completed at the rate of 40 to 45 surface feet per minute, according to diameter. Two die heads can be operated on separate jobs, with separate operators, or both heads can be fed by a single operator. This Landmaco Double will cut threads ranging from $\frac{1}{4}$ " to 1" in diameter, providing the versatility essential in any job shop. Larger Landmacos will handle a range from $\frac{3}{8}$ " to 2 $\frac{1}{2}$ " diameter.



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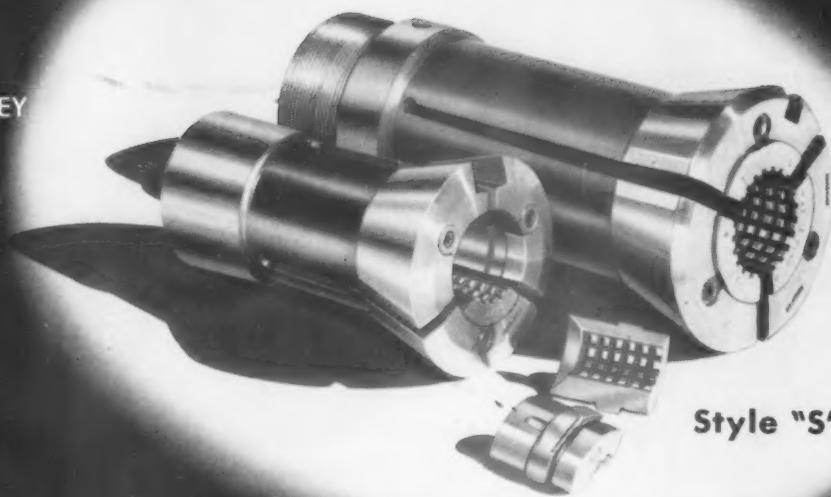
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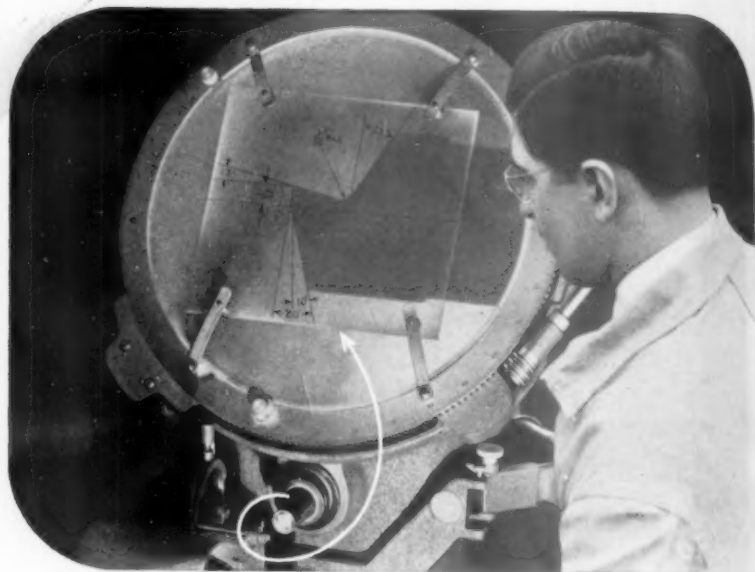
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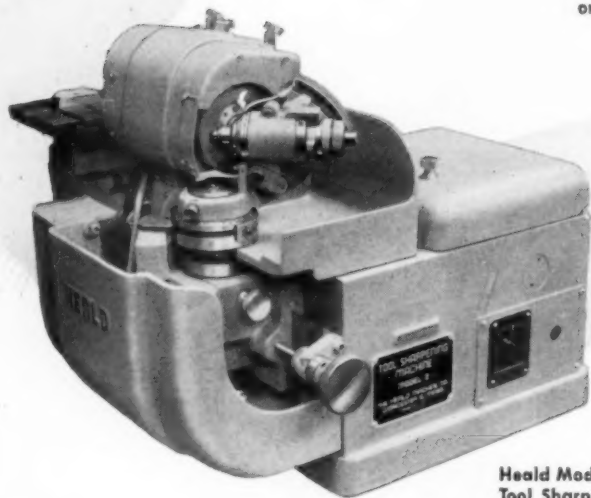
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your cutting tools
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Comparator proves that exact reproduction of tool shapes can be obtained only by automatic lapping on a Heald Tool Sharpener.



Heald Model 2
Tool Sharpener

WHERE schedules call for the maximum in both precision and production, it pays to take a good look at your *borizing tools*.

Are they being lapped by hand, with the possibility of human errors in the duplication of the required shape—and with microscopically irregular edges? If so, you can get

- TOOLS LAST 2 TO 4 TIMES LONGER
- MORE WORKPIECES PER SHARPENING
- LESS MACHINE DOWN TIME

higher sustained production, with increased precision and better finish, by using the Heald Model 2 Tool Sharpener.

This machine sharpens any borizing or cutting tool automatically—produces sharp, flawless cutting edges, and consistently duplicates the exact tool shape required, over and over again! Up to five different angles plus the radius may be preset on precisely calibrated scales, the tool inserted in the holder—and that's all there is to it. Operation is fully automatic, eliminating the possibility of human error.

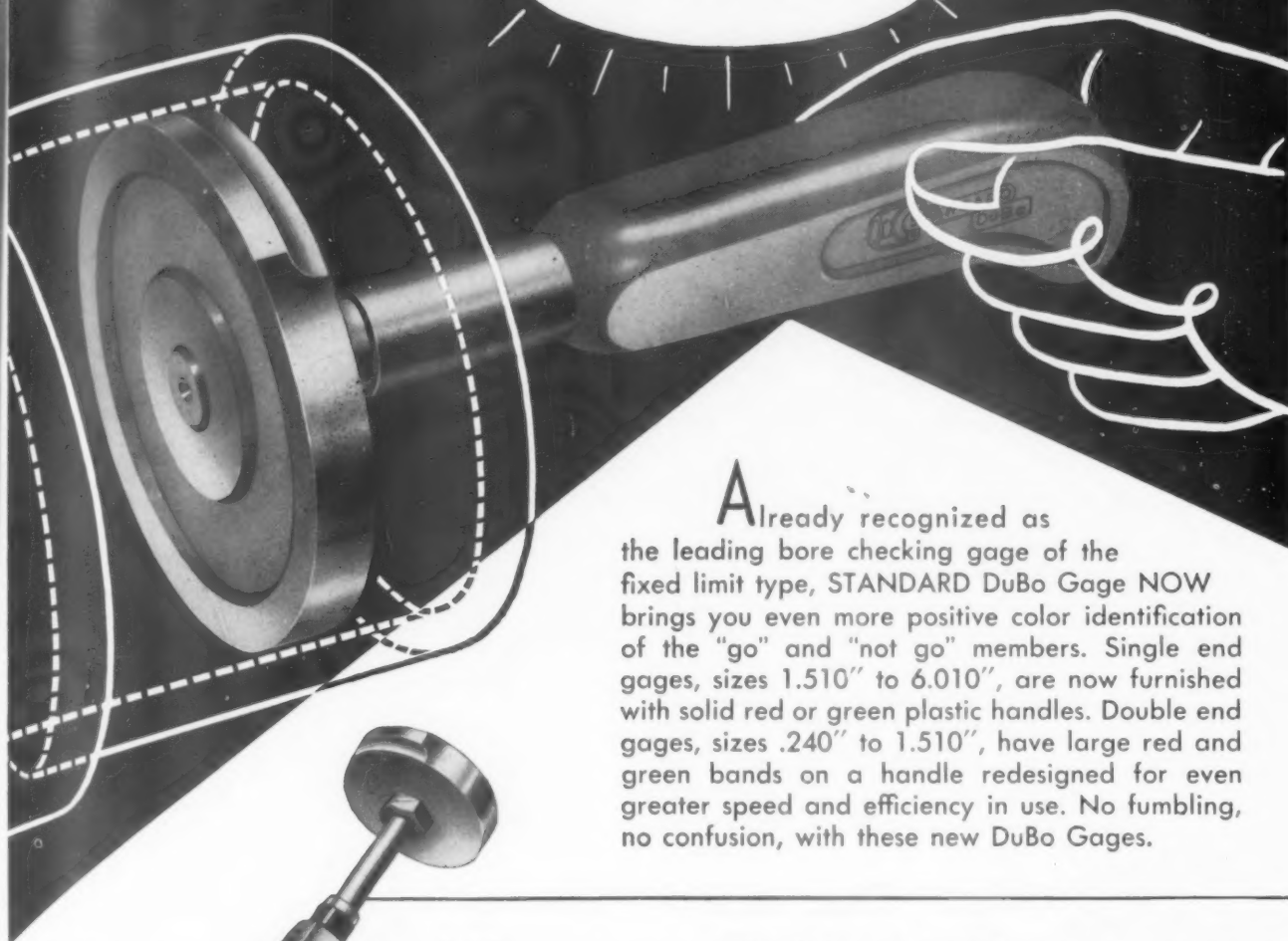
Your nearest Heald representative will be glad to give you complete information on this time-saving, cost-cutting Tool Sharpener. Remember—when it comes to precision finishing, it pays to come to Heald.

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Double end
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 for small
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Among the many mechanical and technical advances incorporated in Winter "Balanced Action" Taps, exact flute spacing is an important element. The spacing is made from index plates of the highest accuracy. Furthermore, once this is accomplished special care is taken to see that the spacing is accurately held throughout subsequent manufacturing steps. Exact flute spacing is an engineered inbuilt feature of Winter Nut Taps, and indeed of the complete Winter "Balanced Action" line. Other Winter Taps available include chip driver, hand, machine screw, pipe, pulley, and taper taps.

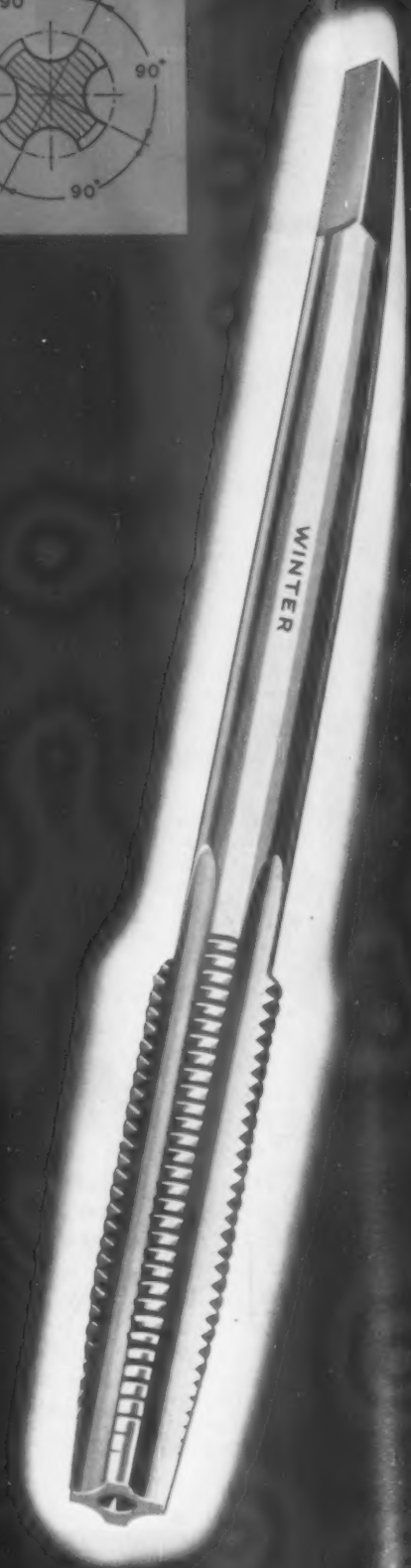
ALWAYS AT YOUR SERVICE — YOUR LOCAL DISTRIBUTOR carries a complete stock of WINTER Taps on his shelves—as close to your tapping problems as the telephone on your desk.



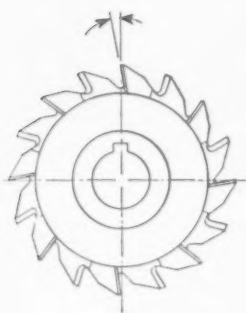
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"CALL YOUR DISTRIBUTOR"—It is NATIONAL'S firm belief, based on long experience, that the local industrial distributor is the one best source for all staple industrial needs—including NATIONAL Metal Cutting Tools.



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Warehouses in New York, Chicago, Detroit, San Francisco



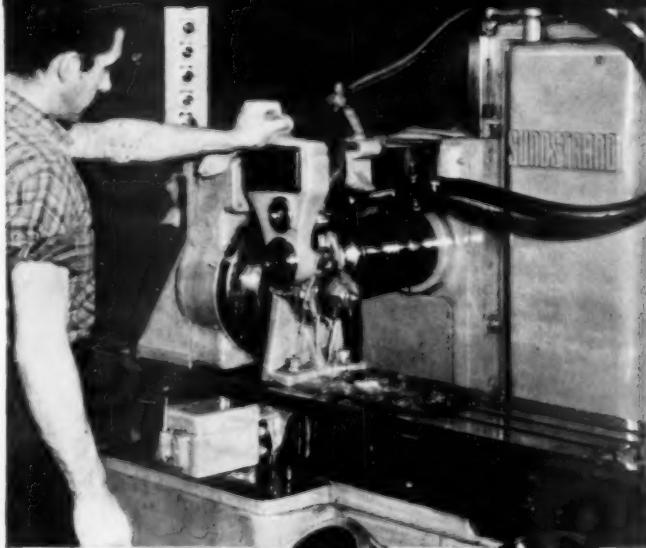
Down job!"

MORSE

Cutting Tools

How **SUNDSTRAND** "Engineered Production" Plus Automatic In- dexing Increases Production On **MILLING JOBS**

There are countless cases where the addition of a relatively simple attachment to a milling machine will increase production sufficiently to eliminate the need for purchase of additional machinery. This is often true with the addition of Sundstrand automatic indexing equipment. Milling problem solutions, like the five examples shown here, are the result of Sundstrand "Engineered Production". Call in a Sundstrand engineer on your milling problems. There is no obligation for this service.



RIGIDMILS • FLUID-SCREW RIGIDMILS • AUTOMATIC LATHES • HYDRAULIC EQUIPMENT

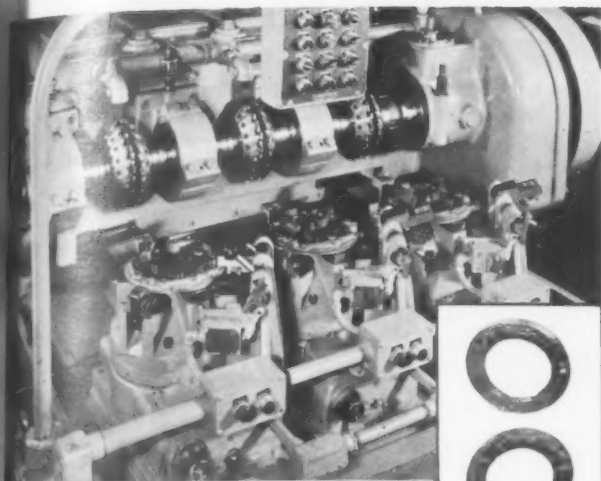


① Loading While Milling, to Produce 800 Pieces Per Hour

This is a standard Sundstrand Rigidmil with standard automatic index base. The index base has 8 work-holding stations with 2 parts held in each station. Parts are located on pins and clamped and unclamped automatically with the movement of the machine table. As idle machine time for loading is eliminated, production rate of 800 pieces per hour can be obtained.

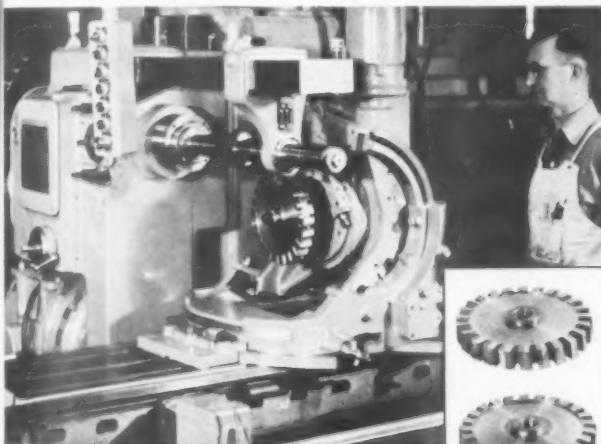
② Milling Multiple Surfaces With One Loading of Part Production Increased 22.5 Times

Here's a good example of the production possibilities available from an automatic indexing base and a standard machine. Milling time was cut from 3 hours per cylinder sleeve to 7.5 pieces per hour. This increased production is due largely to the use of a standard automatic index base in conjunction with a standard vertical feed attachment. These attachments provide a complete automatic cycle for milling 12 grooves in each cylinder sleeve.



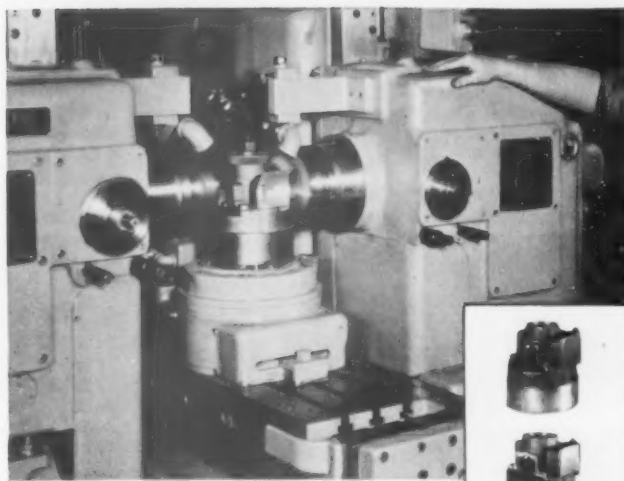
③ Straddle Milling 3 Clutch Plate Lugs Per Machine Cycle ... 240 Plates Per Hour

This is a special Sundstrand Rigidmil with 3 automatic index bases. The machine has a traveling head with a single spindle driving 3 sets of cutters on an arbor. The head cycle and indexing fixtures are timed so that each indexing fixture rotates 120° as the head rapid returns from a cut. One part with three lugs, straddle milled and slotted is completed each machine cycle.



④ Milling Time On Cutter Bodies Cut 46%

This standard Rigidmil has a vertical power attachment for positioning the head and a universal type indexing fixture for milling tooth slots and chip clearance in cutter bodies. Fixture can be set 45° to the right or left of the horizontal center line and up to 10° past the vertical center line or a total of 100° movement. Pieces range from 4" to 14" diameter and lot sizes from one to eleven.



⑤ Production Increased From 30 To 67 Pieces Per Hour With Duplex Mill And Automatic Index Base

Four surfaces of the cast iron compressor block shown are milled on a standard Model 22 Sundstrand Rigidmil. This machine is of the duplex type and provided with a Sundstrand standard Automatic Index Base attachment. In using the duplex type machine and providing an automatic indexing cycle, all four sides are machined in two passes of the table and one handling of the part. This results in greater accuracy and eliminates spoilage.

Production of this machine is more than double that of the unit replaced. It produces 67 pieces per hour at 85% efficiency. The old milling setup turned out 30 pieces per hour.

FREE Additional Data

For more information on Sundstrand "Engineered Production" on milling jobs, write for these booklets. Ask for bulletins 705.



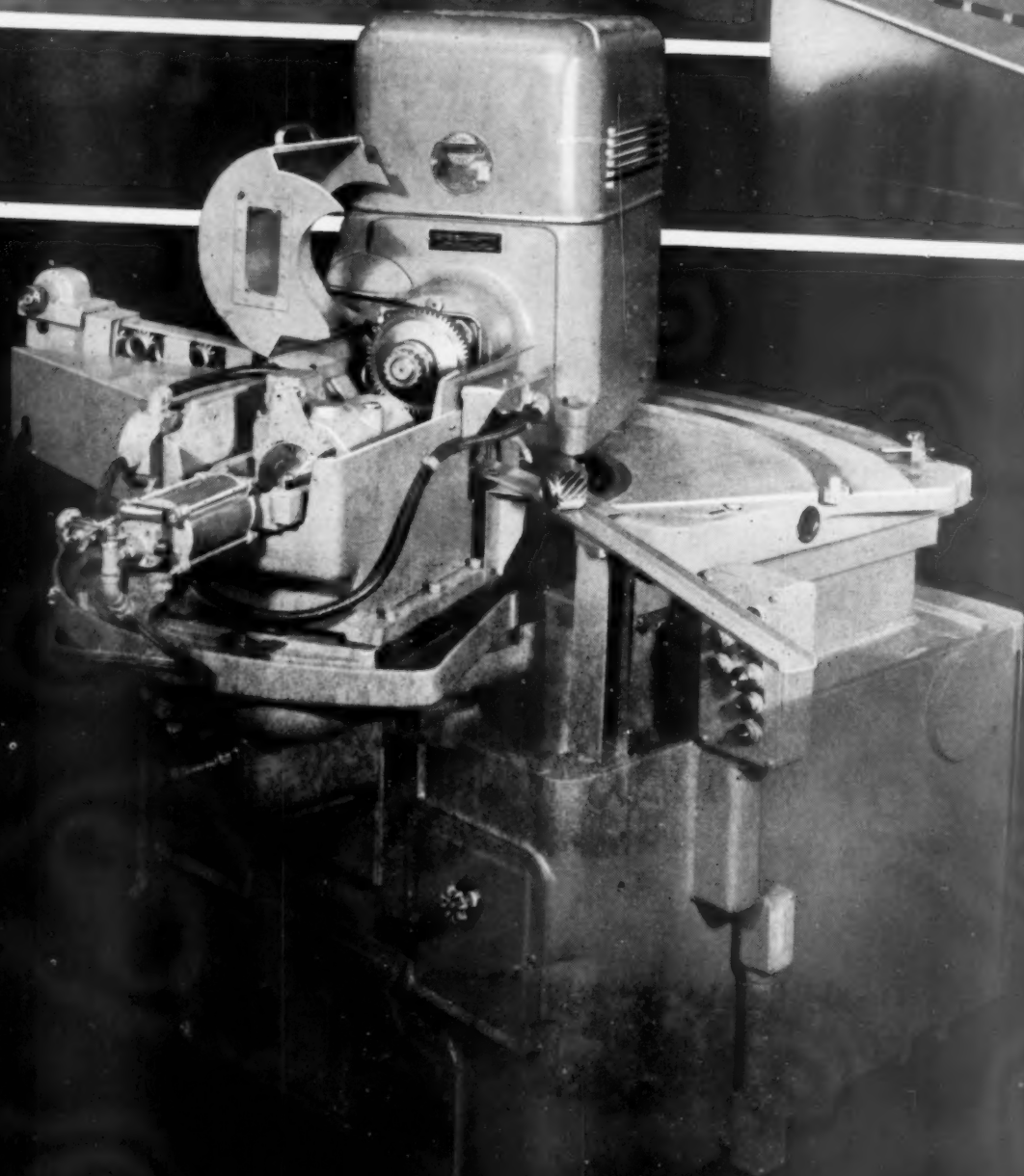
SUNDSTRAND Machine Tool Company

2540 Eleventh St. Rockford, Ill., U.S.A.

DRILLING AND CENTERING MACHINES

SPECIAL MILLING AND TURNING MACHINES

'Full Tool' Shaving



GEAR SHAPERS
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still *faster* with
Automatic loading
and unloading

**Magazine Feed Still Further Reduces
the Operating Effort Required**

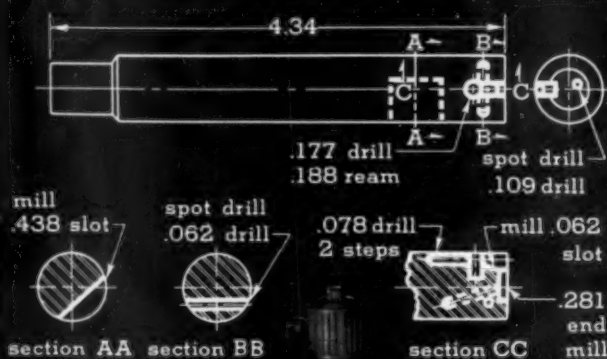
Fellows 'Full Tool' Shaving is essentially an extremely high speed operation. . . . The shaving time per gear or pinion can be so short that loading becomes an important time-economy factor. . . . Hence Fellows optional addition of magazine type Automatic Loading and Unloading! . . . The air-actuated work positioning, clamping and ejection are split-second timed into the automatic cycling of the machine. . . . The resulting overall speed sets new standards—from which our engineers will be glad to quote rates on specific gears and pinions. . . . For data, call on the nearest Fellows office.

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Rifle bolt for 11 operations from 5 directions

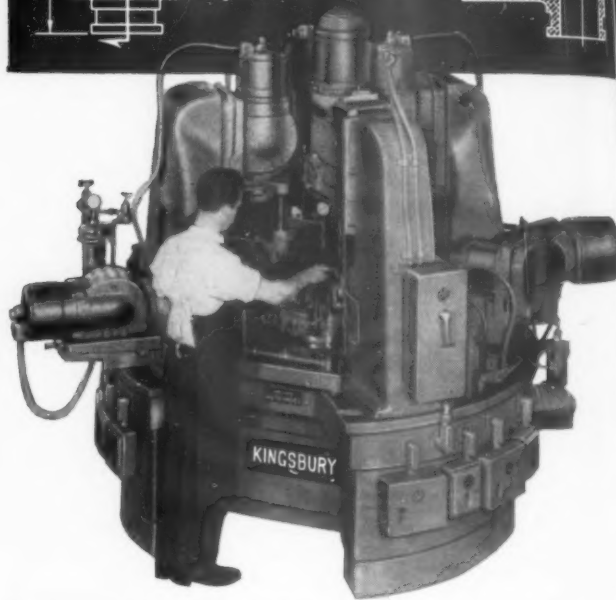
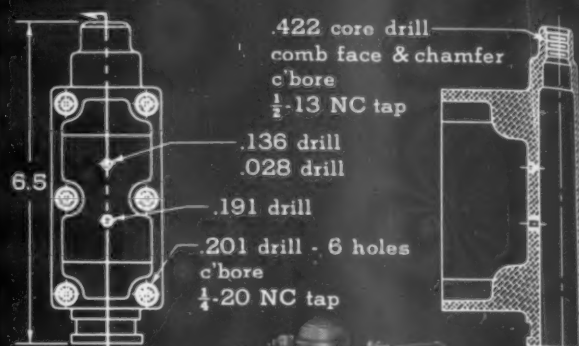
27¢ per part



330 PARTS AN HOUR GROSS. On this 40-inch "Auto-Index" a vertical unit mills the .438 slot; four units on the central column and inverted at 45° do the .062 and .188 holes; six units on the base do four axial operations and the .109 angular hole.

Master cylinder for 25 operations from 2 directions

11¢ per part



630 PARTS AN HOUR GROSS. A 20-inch power index table has eight fixtures. Four vertical units operate on the axial hole. Six horizontal units, three with 6-spindle auxiliary heads, operate on the other holes. The .028 drill runs at 14,000 rpm.

Cut unit costs with many

High production drilling and tapping machines, either simple or complex, combine operations to save money

Dear Sir:

These high production machines save money. The pay-off period is one to three years, or even less.

Each machine here replaces several general-purpose machines. One man loads and unloads each one. Automatic drilling and tapping units of 1/3 to 5 hp do the operations. That means a big saving in direct labor, some saving in handling and space.

Scrap is less, since each machine produces uniform, accurate parts. Automatic work cycles never vary. Fixtures and index tables are jig-

bored to such close limits that parts from all fixtures are exactly alike. Bushings locate drills and reamers to close tolerances.

Savings not always obvious

"A new Kingsbury," says an article in *American Machinist*, "drills, reams and countersinks both ends of a small roller, has cut time to only 0.18 min. per piece. Even though there is only enough work to operate it about a week a month, it has already paid out in labor and scrap savings."

Firms have ordered Kingsburys

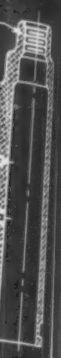
when they needed only 25 or 30 parts an hour. You might think those machines would be a poor investment. But in each case someone figured out that there would be a good saving.

Not on old envelopes now

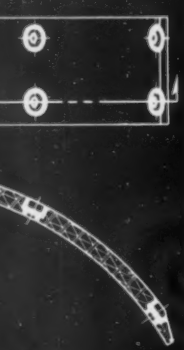
It used to be that you could take a proposal and figure the savings on any handy piece of paper. Nowadays many people use a work sheet of some kind. For one thing, it is easier for others to follow the figuring.

There is a good work sheet in the National Machine Tool Builders' booklet, *Computing Return on Invested Capital*. They describe the method fully. If you want a book-

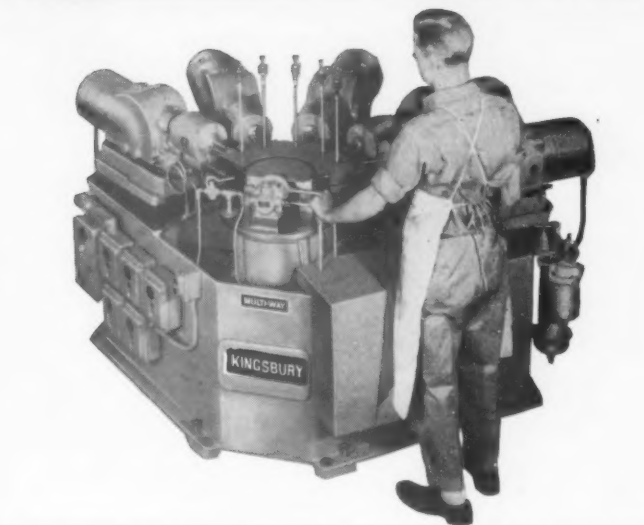
r parti
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$\frac{6}{10}$ ¢ per part
directions



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830 PARTS AN HOUR GROSS. Drop a part in the fixture and trip a lever. The fixture locates and clamps. Five 2-spindle units operate. The fixture unclamps and ejects. Time: 3½ sec. The operator can adjust the units to operate on similar linings.

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but you can use *actual* figures. You get a realistic result, whether or not your machine runs full time.

Instead of an average hourly wage you can use your actual wage (with or without hourly fringe benefits). Instead of output in 6000 hours, you can use your output in either your pay-off or "useful life" period.

You can complete the picture by comparing that cost with your unit

cost now and estimating savings in overhead. That was beyond us here.

Don't get us wrong. Savings are often so obvious you need not figure them on paper. But you can't judge savings without proposals. If you want us to quote, send a print to our Mr. L. A. Carll and tell him the operations and output you need. Free bulletins show what we can do.

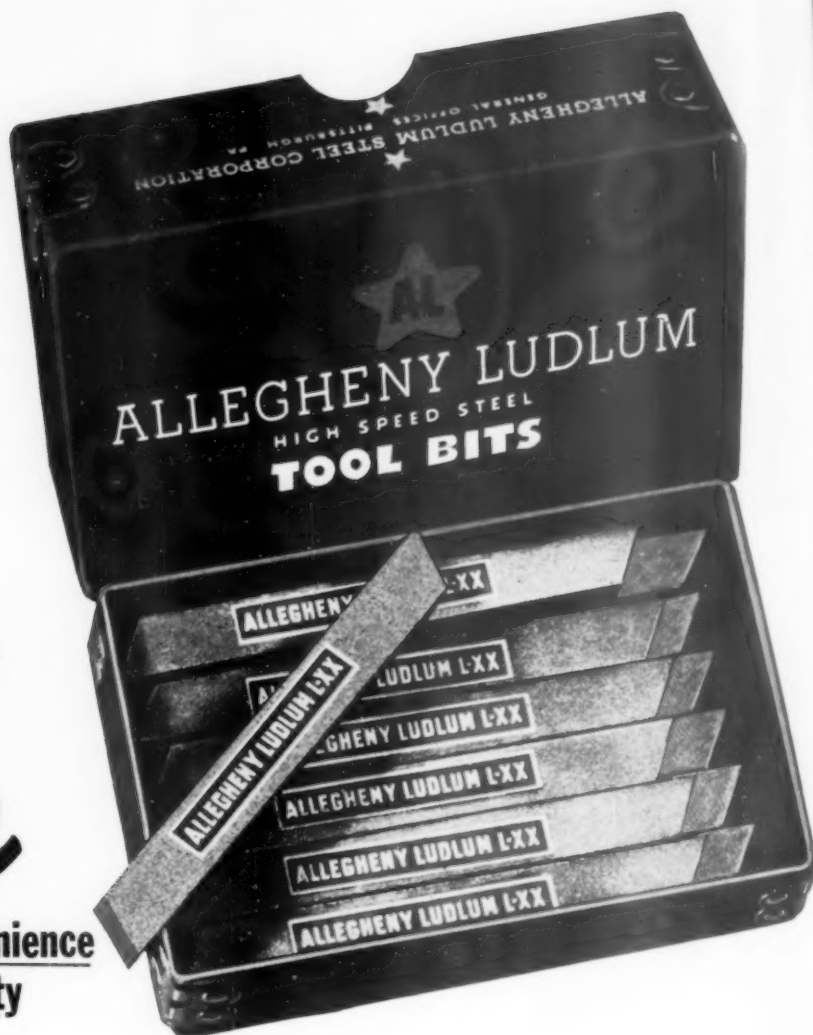
Sincerely,
Kingsbury Machine Tool Corp.
140 Laurel Street, Keene, N. H.

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AUTOMATIC DRILLING & TAPPING MACHINES

Ready Made

—these bits give you convenience
economy, dependability



- SUPER PANTHER • PANTHER SPECIAL
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Just send a postal-card request—giving name, position, company, and address. Ask for "A-L Tool Bit Price List," pocket edition. While you're writing, also include the illustrated four-page folder, "A-L Mill Treated High Speed Steel Tool Holder Bits." Yours for the asking.

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ADDRESS DEPT. TE-15

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Since 1854*



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BUILT FOR MAXIMUM ECONOMY, Union end mills provide top performance throughout the range of end milling operations. Made of high speed steel, they have the smooth, free-cutting action that saves power, while their great strength reduces breakage to a new low. And all Union solid type end mills of $\frac{1}{2}$ " diameter or over have deep counterbores, considerably lengthening their resharpening life. In fact, as with all Union cutting tools, every detail of their design and construction is the result of up-to-the-minute tool

engineering that saves you time, labor and money . . . *And that's worth specifying!*

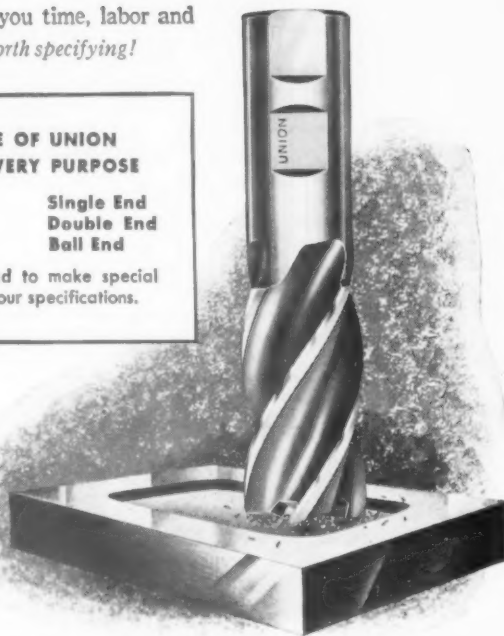
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END MILL FOR EVERY PURPOSE**

**Taper Shank
Straight Shank
Shell**

**Single End
Double End
Ball End**

Union is also prepared to make special types of end mills to your specifications.

*no other end mill
will outperform* a **UNION**



contact your local distributor

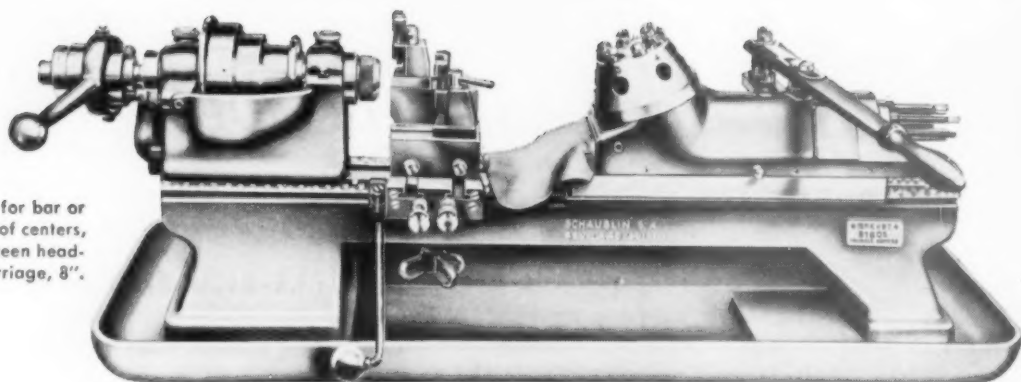
His name is listed in Union's THOMAS' REGISTER insert under "Drills, Twist."

UNION TWIST DRILL COMPANY, ATHOL, MASSACHUSETTS



We own and operate S. W. CARD MANUFACTURING CO. Division, Mansfield, Mass. Taps, Dies, Screw Plates . . . BUTTERFIELD DIVISION, Derby Line, Vt., Taps, Dies, Screw Plates, Reamers . . . BUTTERFIELD DIVISION, Rock Island, Que., Milling Cutters, Twist Drills, Hobs, Reamers, Taps, Dies, Screw Plates.

SV 70 Turret Lathe for bar or chuck work. Height of centers, 2.8". Distance between headstock and turret carriage, 8".



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These SV Machines fully warrant your inquiry for complete information. They have contributed greatly toward winning for the Schaublin line a fine reputation for the adaptability and precision that are highly prized by toolmakers. Factory service, interchangeable units and accessories are available from American warehouses. Consult us on your tool-making problems.



SV 102 Toolmakers' Lathe for which great variety of independent and interchangeable units and accessories are available.



SV 12 High-Precision Milling Machine — one of five different types. Table sizes 4-23/32 X 16-1/2" to 10 X 43-5/16".

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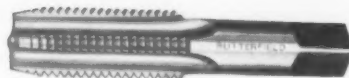
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Spiral Fluted. High speed steel. Correct spiral for free cutting while ejecting chips from hole.

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Stub Fluted. High speed steel. For threading holes in thin sections.

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Spiral Pointed. High speed or carbon steel. For tapping deep through holes or holes deep enough to allow bottom chip clearance.

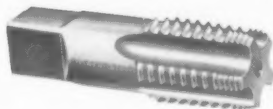


Stub Fluted. High speed steel. For threading holes in thin sections.

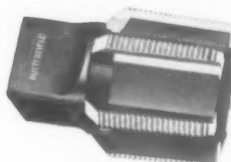
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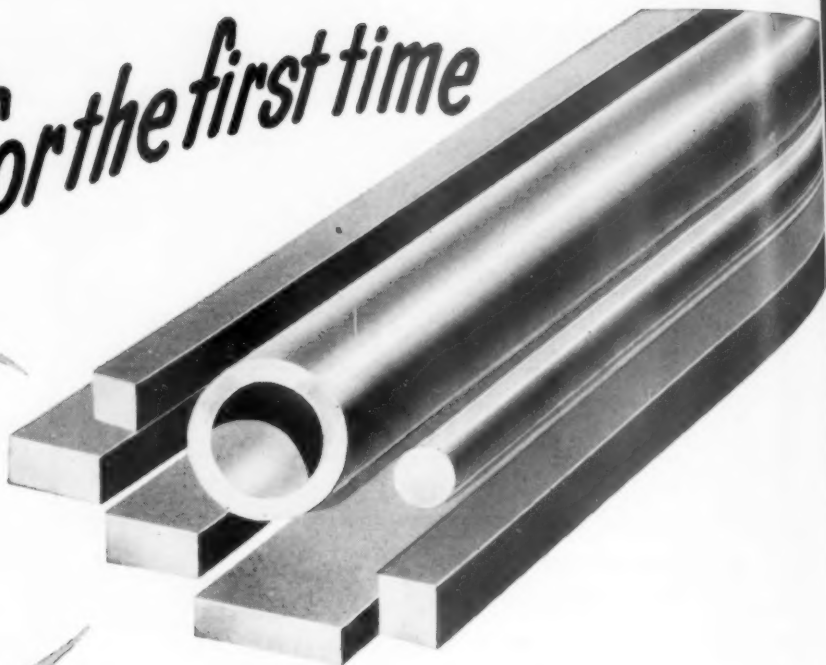
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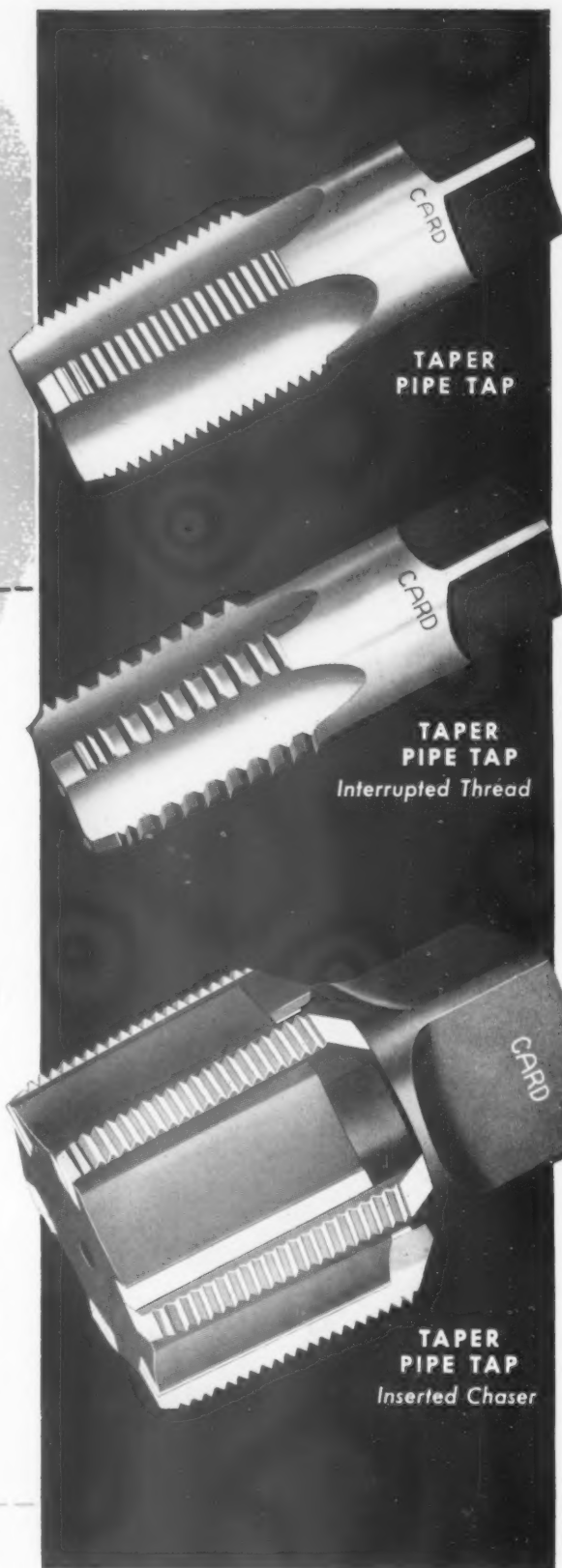
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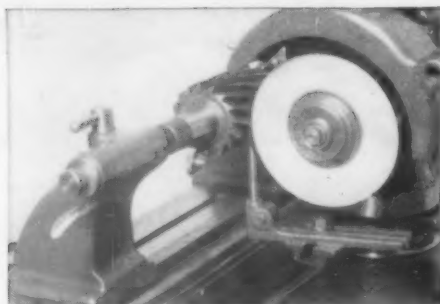
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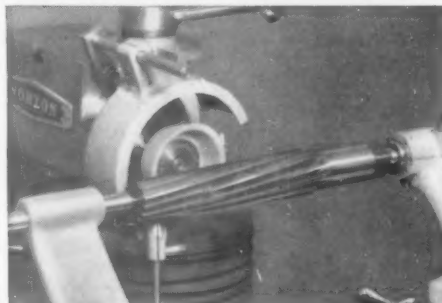
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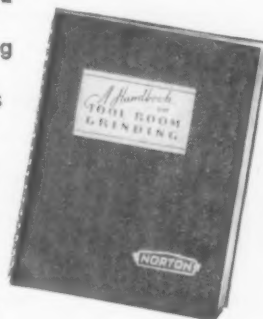


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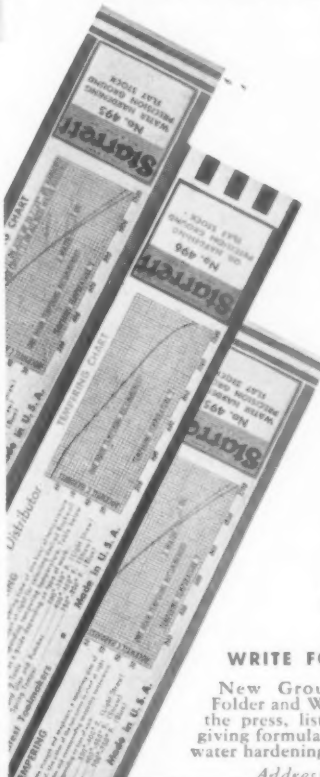
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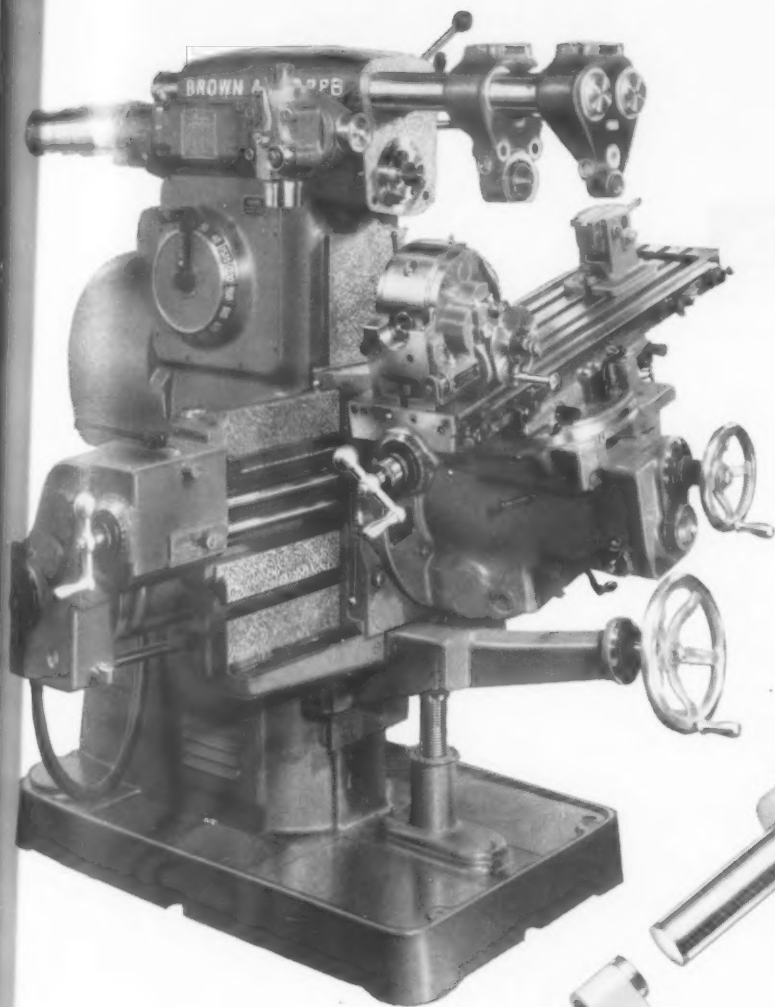
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THE TOOL ENGINEER

Publication of The
American Society of
Tool Engineers

The Tool Engineer

a Letter from the Editor...

This month *The Tool Engineer* brings you an advance printing of five of the technical papers scheduled for presentation at ASTE's annual meeting in New York a few weeks from now.

All in all, there are twenty-eight important papers on the New York program, and a substantial number of them will appear shortly in *The Tool Engineer*. There's quite a bit of planning behind the publishing of these papers, and it's indicative of the progress of our Society.

As you've been quick to notice, the number of technical sessions at annual meetings of ASTE has increased manyfold over the programs of a few years ago. Naturally, the interest created by expanded programs encouraged Society officers to plan for even larger technical programs with a wider coverage of tool engineering.

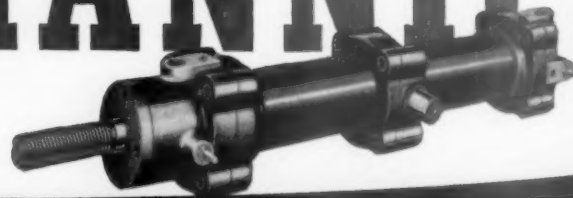
Selected papers from various sessions have been published in the past by *The Tool Engineer*, to give the papers the coverage and attention that they deserved. And, beginning with the Exposition papers last spring, *The Tool Engineer* has encouraged development of specific technical sessions which are "hot" for publication, and which tie in with the carefully-planned content of *The Tool Engineer*.

In the future, this will bring you even more top coverage and exclusive tool engineering reports. Many more important technical papers, edited down to article form, and developed for program-magazine coverage, is the promise as a result of extensive coordination of Society facilities.

Gilbert P. Linn

Note: The special photographic plant tour of Aluminum Company of America's Edgewater, N. J., plant, originally scheduled for this issue, has been omitted because of security regulations which also caused cancellation of the Society's tour of the plant.

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The Tool Engineer

Editorial

Education for Defense

WE HAVE POINTED OUT in this column the importance of production in war, and the responsibility which we have as individuals and as a society to make that production possible.

The Nineteenth Annual meeting of our Society, a few weeks away as this is being written, presents the strongest and most complete production and tooling forum ever undertaken by ASTE. The more than thirty technical papers to be presented in New York reflect both the importance of the tool engineer in this defense effort and the wide responsibilities which he must assume.

Led by the Mobilization Technical Know-How Conference on March 14, the technical program at this meeting embraces cutting, pressworking, plant layout and control, machine controls, quality control, materials and tool engineering methods. To say that this accumulation of technical data is valuable to the tool engineer is an understatement; it is the means by which he keeps abreast of his profession and the constantly changing methods in his profession which make for better, faster and more economical production.

Prepared discussions have been introduced for this meeting; they will provide a considered, studied supplement to the technical discussions from the floor at meeting sessions.

The assistance which such a technical program can provide to tool engineers is almost without limit, depending only upon the number of participating tool engineers. In other words the program, as well as ASTE's many other services, are valuable only insofar as they are used by tool engineers, and to the degree that tool engineers participate in their preparation, discussion, presentation. As the value of any effort is enhanced by the addition of intelligent minds, so the value of ASTE's educational efforts increases in direct ratio to the number of individual tool engineers taking part in that program.

By our attendance at our Society meetings, our participation as speakers or discussors, our contributions to ASTE literature and our work on behalf of our Society committees, we can collectively work educational miracles!

H. L. Tigges

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1950-1951

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RIGID INSPECTION PRACTICES

Raising the Limits of High Speed Steel Machining

By W. R. Frazer

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PRODUCTIVITY PER MAN-HOUR and cost of manufacture are influenced by rate of production, quantity produced per grind of tool and number of sharpenings per tool. The cost is lowered when all these items are high. Therefore, the combined efforts of the machine tool builder and cutting tool manufacturer to work toward this goal is essential. The limit to which we can go depends largely on the adaptability and limitations of the machine tool. If there is sufficient power and speed with suitable feed and rigidity as required by carbide tools, you will proceed with the application of these extremely important materials, since they will do an outstanding production job when properly engineered. There are, however, many operations that are not equipped with machine tools adapted to carbide tooling, but they are capable of utilizing the improved physical properties of the higher alloyed high speed steels.

The steels we are going to discuss are shown in Table I. We have taken the liberty of classifying those steels with carbon above 1.00 percent as being of the so called "super" variety.

The cutting ability of any tool material depends on a combination of physical properties which are closely related. To resist abrasion, the material must possess high hardness at the operating temperature of the cutting edge. To resist chipping of the cutting edge or breakage of the tool, the tough-

ness of the material must be adequate for the operation. Studies have demonstrated that these properties can be varied by heat treatment and changing the chemistry of the steel. In Table II Desilets demonstrates that the hot hardness of high speed steel increases as the hardening temperature is increased. You will also note that the room temperature hardness (70 deg F) increases with hardening temperatures and the hot hardness decreases as the tool temperature rises from 1050 deg F through 1100 deg F to 1150 deg F. Gill shows that hot hardness changes with the chemistry; cobalt and vanadium being very effective in producing higher red hardness. Here we see that 5.00 percent cobalt (T-4) added to an 18-4-1 high speed steel (T-1) causes an increase of 12 percent in hot hardness at the three temperatures studied. Also, the increase of vanadium in T-15 improves the hot hardness

TABLE I—CLASSIFICATION OF CONVENTIONAL AND SUPER HIGH SPEED STEELS

Code	Conventional High Speed Steels					
	C	W	Cr	Va	Mo	Co
T1	0.72	18.00	4.00	1.00		
T2	0.82	18.00	4.00	2.00	0.75	
T5	0.82	18.00	4.00	2.00	0.75	8.50
M1	0.82	1.50	4.00	1.00	8.50	
M2	0.82	6.00	4.00	2.00	5.00	
M10	0.82		4.00	2.00	8.00	
Super High Speed Steels						
T3	1.05	18.00	4.00	3.00	.75	
T15	1.55	13.00	5.00	5.00		5.00
M3	1.20	6.00	4.00	3.00	6.00	
M4	1.25	5.50	4.00	4.00	4.50	

To be presented at Annual Meeting, American Society of Tool Engineers, March 15, 1951.

TABLE II—EFFECT OF HARDENING TEMPERATURE AND ALLOY CONTENT ON HOT HARDNESS

Hot Hardness (T1 Steel) vs. Hardening Temperature (Desilets)				
Harden- ing Tem- perature deg F	70 deg F	1050 deg F	1100 deg F	1150 deg F
2000	61.0	45.5	42.8	38.5
2200	62.5	52.5	51.6	48.0
2300	63.5	55.5	53.5	51.0
2350	64.5	57.0	55.0	52.4
2400	65.0	57.2	55.4	52.6
All samples tempered 1050 deg F—2½ hrs before testing				
Hot Hardness vs. Alloy Content (Gill)				
Classifi- cation	W	Composition Cr VA Co Mo	Brinell Hardness 1000 1100 1200 deg F deg F deg F	
T1	18.00	4.00 1.00	510	480 337
T4	18.00	4.00 1.00 5.00	575	520 400
T15	13.00	5.00 5.00 5.00	677	576 462
M1	1.50	4.00 1.00 8.50	475	308

over T-4 by another 15 percent. T-15 super high speed steel possesses a hot hardness of about 35 percent more than T-1 or M-1, which equal each other in this property.

Hardening vs. Toughness

As for toughness, we show in Table III the results obtained by Grobe and Roberts^{1*} in their study of the effect of hardening temperature on bend and impact tests, which are a measure of toughness. These data establish the relationship of hardening temperature and grain size to toughness; the coarser grain size of the higher hardening temperature producing lower impact strength and plastic deflection at corresponding tempering temperatures. For example, hardening M-2 steel at 2175 deg F and tempering at 1050 deg F for 2½ hours plus 2½ hours will produce 14.7 grain count, 62.4 ft-lb impact strength, 0.44 in. plastic deflection and C-62.9 Rockwell hardness. If hardened at 2225 deg F and tempered as above, the grain count is 13.5, impact strength 48.7 ft-lb, plastic deflection 0.016 in., and hardness C-64.6. The lower hardening temperature

* Figures refer to the references appended to this paper.

TABLE III—EFFECT OF HARDENING TEMPERATURES ON BEND AND IMPACT VALUES

Bend Test and Unnotched Izod Impact Results M2 (6-5-4-2) High Speed Steel Hardened from 2175 and 2225 deg F Tempered 2½ hr and 2½ hr from 950 to 1150 deg F (Grobe and Roberts)					
Harden- ing Temp. deg F	Grain Size	Temper- ing Temp. deg F	Average Impact Ft—Lb	Plastic Deflec- tion Inches	Hardness Rockwell "C"
2175	14.7	950	45.6	0.006	65.3
		1000	53.0	0.015	64.6
		1050	62.4	0.044	62.9
		1100	57.9	0.084	60.1
		1150	66.6	0.155	55.1
2225	13.5	950	36.1	0.005	66.1
		1000	41.9	0.006	65.7
		1050	48.7	0.016	64.6
		1100	47.3	0.030	61.2
		1150	53.0	0.104	56.2

TABLE IV—EFFECT OF HARDENING TEMPERATURE ON GRAIN SIZE AND TEMPERED HARDNESS

Grade	Compo- sition	Hard- ened Deg F Salt	Grain Size	As Hard- ened	Hardness after Tempering*		
					1000 deg F	1025 deg F	1050 deg F
T1	18-4-1	2250	14.4	65.0	64.1	63.6	63.1
		2300	12.6	65.1	64.0	64.9	64.0
		2350	11.9	65.8	65.1	65.2	65.0
T5	18-4-2-9	2300	14.0	64.4	65.9	64.8	64.0
		2350	13.3	63.9	66.2	65.6	65.0
		2375	9.6	63.4	66.3	65.1	64.7
T15	13-5-5-5	2150	13.8	67.0	66.1	65.1	64.5
		2200	12.1	66.1	66.9	66.0	65.2
		2250	10.8	65.8	67.9	66.7	66.2
M1	1.5-8-4-1	2125	15.3	64.9	65.0	64.1	63.9
		2175	13.7	64.1	65.2	65.0	64.3
		2225	12.3	63.3	65.9	65.8	65.0
M2	6-5-4-2	2150	14.0	64.7	64.4	63.0	63.0
		2200	11.3	65.0	65.0	64.1	63.8
		2250	10.7	66.1	66.0	65.1	64.7
M3	6-6-4-3	2150	14.2	65.1	65.0	65.0	63.5
		2200	12.4	65.7	66.1	65.4	64.1
		2250	12.7	63.9	67.0	66.6	65.9
M10	8-4-2	2150	12.8	64.9	64.3	64.0	62.8
		2200	10.9	64.7	64.5	64.1	63.6
		2250	9.7	64.1	65.9	65.0	64.0

*All tempering 2 and 2 hours

produced a tougher piece as measured by grain count, impact strength and plastic deflection at a sacrifice of hardness.

Let us compare the hardenability of some of the steels shown in Table IV. T-1, M-1 and M-2 steels are very much alike in grain size and hardenability at the several hardening temperatures used. It is apparent from these data that T-5, with more vanadium and 9.00 percent cobalt, possesses greater hardenability than T-1. It coarsens at 2375 deg F. By increasing the vanadium and decreasing the cobalt, as in T-15 steel, we obtain extremely high hardness values with relatively fine grain size, which demonstrates the refining effect of vanadium. This is also demonstrated when we compare M-1, M-2 and M-3. The first two steels are very much alike, but the higher vanadium in M-3 helps to produce high hardenability with fine grain. M-10 steel, containing no tungsten, seems more susceptible to grain growth like T-5.

Reviewing the data given in Tables I through IV we can conclude that

- I—Hot hardness of high speed steel increases with hardening temperature.
- II—Hot hardness of high speed steel increases with room temperature hardness.
- III—Hot hardness of high speed steel increases with alloy content.
- IV—Lower hardening temperature and/or finer grain size produces greater toughness, but lower hardness.
- V—Higher alloy content of super high speed steels produces greater hardenability with relatively fine grain size and consequent good toughness.

Carbide Hardness in High Speed Steel

The development of microhardness testing instruments has made it possible to determine the hardness of individual carbide particles in steel instead of the average hardness of matrix and carbides as measured by a standard Rockwell tester. Tarasov² has made a study of carbide hardness and found the Knoop hardness to be as shown in Table V for the various materials listed.

The complex carbides in high carbon-high vanadium high speed steel (T-15) are harder than aluminum oxide, which is used as an abrasive material in grinding wheels. Blickwede, Cohen and Roberts³ studied the effect of vanadium on M-2 type high speed steel and learned that the hardened steel contains two excess types of carbide particles; one being a complex tungsten-molybdenum rich carbide identified as M₆C, the other being a vanadium rich carbide identified as MC. Peter Leckie-Ewing⁴, one of the author's associates, has carefully studied the microhardness of carbides in high speed steels and has found two ranges of hardness. Using a selective etching technique, he was able to identify the harder carbide as vanadium carbide (MC) with a hardness equivalent to C 84.0-85.0, whereas the softer carbide is the tungsten-molybdenum carbide (M₆C) with a hardness equivalent to C 74.0-77.0.

In Fig. 1 we see the hardness of MC in T3 (18-4-3) steel is C 84.0 with a matrix hardness of C 66.0 whereas the hardness of M₆C in T-1 (18-4-1) steel is C 75.0 with a matrix hardness of C 65.0. Fig. 2 shows the hardness of a tungsten carbide particle in 883 grade Carboloy as being equivalent to C 82.5, indicating that the vanadium carbide particles in the high vanadium steels are slightly harder than tungsten carbide particles in sintered carbide. The average hardness of this steel, as measured on a standard Rockwell hardness tester,

Fig. 1. Comparison of hardness. At left is super high speed steel T-3 (18-4-3); at right is standard high speed steel T-1 (18-4-1). Mag. — 2000X; etch, 2% nital. Microhardness converted to Rockwell C:

Steel	Matrix	Carbide
T-3	66.0	84.0 (MC)
T-1	65.0	75.0 (M ₆ C)

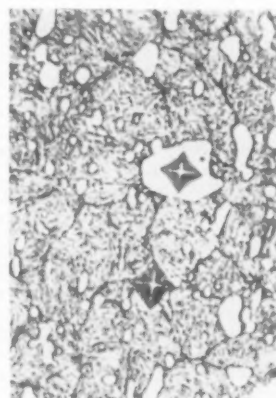
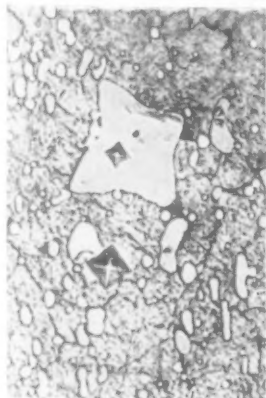


TABLE V—MICROHARDNESS OF ABRASIVE GRAINS AND OF CARBIDES IN STEEL

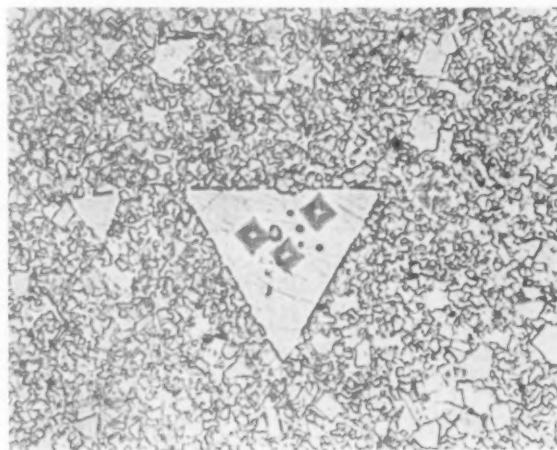
By L. P. Tarasov

Material Indented	Knoop Hardness Average	(K25) Range	No. of Indents
Oil hardening toolsteel (Rc 60½)	790	770- 880	4
Cementite (in plain carbon toolsteel)	1150	1060-1240	8
Complex chromium-iron carbides (in high-C high-Cr steel)	1820	1690-1960	7
Aluminum oxide (in regular Alundum abrasive)	2440	1900-2920	19
Complex vanadium carbides (in high-C, high-V high speed steel)	2520	2340-2760	8
Silicon carbide (calculated from data for 100-g. load)	3590	3070-3980	200

is considerably lower than that of the sintered product. Studies of various steels show that the amount of the hard MC carbide in T-1 and M-1 high speed steel is very small, the carbides in these steels being the softer M₆C type. As vanadium is increased, the amount of MC carbide increases proportionally and account for 30 to 40 percent of the total carbides present in the high vanadium steels. It is the presence of these very hard and stable carbides that make these high vanadium steels so resistant to wear and abrasion.

The very great hardness of the vanadium carbide particles in the super high speed steels, which gives them hardenability, hot hardness and resistance to abrasion with relatively fine grain size, naturally presents a grinding problem, as discussed by Tarasov⁵, who has measured the grindability of various tool steels are all more difficult to grind than the conventional high speed steels and therefore present more of a problem as regards developing cracks and wheel burn. The grinding wheel

Fig. 2. Tungsten carbide in Carboloy grade 883. Mag. — 2000X. Microhardness converted to Rockwell C is 82.5.



manufacturers have studied the problem and are now able to make recommendations of wheels to use and proper technique to follow for the satisfactory grinding of these materials.

With this brief discussion of the metallurgical reasons for developing the super high speed steels, we give in Table VI a few applications where satisfactory results have been obtained. These case histories are not complete in some instances, but they do give sufficient information to demonstrate the success of these steels in industry. You will note that although the production ratio of the super high speed steels versus conventional high speed steels is 1 to 1 in most cases, the tool life ratio increases from 2 to 1 to as high as 14 to 1. This, of course, means longer runs between grinds which will effectively decrease costs and increase production.

High Rake Angle Cutters

Now we will discuss recent developments in milling cutter design where high rake angles—both radial and axial—are used. Hans Ernst and his associates at Cincinnati Milling Machine Company have demonstrated that as the positive rake angle of a planning tool is increased, the chip shear angle is increased, resulting in a thinner chip at the same depth of cut. This principle of the high rake as studied on a planning tool has been applied to the design of milling cutters—both profile and form—with results that are worthy of your study and consideration. We are frank to admit that there are many questions that can't be answered regarding these cutters. The studies have been carried on only for about three years and much is to be learned concerning this subject. However, the results obtained are so outstanding that we wish to mention them to you and hope to create sufficient interest,

so you will try these high rake cutters on your own milling operations.

One of the earlier applications of high rake milling was at Greenfield Tap and Die Company, who are climb cut fluting $\frac{1}{2}$ in. carbon and high speed steel taps at 320 sfpm and 55 ipm feed, obtaining 80 to 125 pieces per grind or 320 to 500 flutes per grind. This is a chip load of 0.006 in. per tooth and with a heavy flow of water soluble coolant, the chips are dull grey in color and flat in shape, indicating a cool operation. This cutter is a profile cutter with 30 deg radial rake and 10 deg axial rake. Hydraulic feed is used on this machine.

High Rake Angles

John Coleman, tool engineer at Threadwell Tap and Die Company, has had interesting experiences with high rake flute milling. Since sharpening of a profile cutter presented a problem, he is using a staggered tooth form cutter with 16 deg radial rake and 30 deg axial rake. On a screw feed machine, he is climb milling $\frac{1}{2}$ in. carbon and high speed steel tap blanks at 137 sfpm with 11 $\frac{1}{4}$ ipm feed giving a chip load of 0.0032 in. He obtains 335 pieces per grind or 1340 flutes per grind, equal to 150 lineal feet per grind. With a conventional form cutter operating at 75 sfpm and 2 ipm or a chip load of 0.0017 in., he obtained only 35 pieces per grind. A water soluble coolant is used.

Walden Sinawski⁶, cutting tool engineer at Jones and Lamson Machine Company is obtaining phenomenal results with high rake cutters. Fig. 3 shows a 34 deg radial rake, 10 deg axial rake, 60 deg included angle cutter he uses for milling the dovetail in high speed steel chasers. This cutter is operated at 187 sfpm with 20 ipm feed or a chip load of 0.005 in. Here a 50-50 mixture of sulphur

TABLE VI—PERFORMANCE DATA—SUPER VS. CONVENTIONAL HIGH SPEED TOOLS

Case	Operation	Material	Convention H.S.S.			Super H.S.S.			Production		Tool Life
			Speed SFPM	Feed IPM	Pcs/Grd.	Speed SFPM	Feed IPM	Pcs/Grd.	Ratio SHS/HS	Ratio SHS/HS	
1	Hack Saw	High Speed Steel	70	1.5	1500	70	1.5	4500	1-1	3-1	
2	Milling	6324	80	1.5	10	80	1.5	57	1-1	5.7-1	
3	Milling	1020	X	Y	1000	2X	2Y	2000	2-1	2-1	
4	Punching	302 Stainless (.062 in. thick)			35,000			150,000	1-1	4-1	
5	Punching	302 Stainless (.036 in. thick)			175,000			750,000	1-1	4-1	
6	End Milling	Alloy Cast Iron	100	3	7	156	4	90	4-3	13-1	
7	Wear Part	Tungsten Filament			4000/7000			49,000	1-1	7-1	
8	Drilling	Stainless Steel			5000			43,000	1-1	8-1	
9	Drilling (21/64 in.)	Cast Iron	100	.010	70	100	.010	800	1-1	11-1	
10	Hobbing	Steel			1			3	1-1	3-1	
11	Milling Slot	Cast Iron	80	6	(.020 in. wear)	80	6	(.009 in. wear)	1-1	3-1	
12	Milling	Cast Iron	90	6	550			1650			
13	Drilling	Cast Iron	162	5	(.040 in. wear)	180	14	(.010 in. wear)	2-1	4.5-1	
14	End Mill	Cast Iron	143	4	2000	162	5	9000	1-1	2.5-1	
15	Broaching	1020			500			13,000	1-1	3-1	
16	Hobbing	1350	114	.060	85	141	.060	283	1-1	14-1	
17	Locomotive Tire Turning	300 B.H. Steel	48	5.5	4 Hrs/Gr			56 Hrs/Gr	1-1	2-1	
18	Cut Off	280 B.H. Steel			17			30	1-1	14-1	
19	Cut Off	E4342			(.015-.020 in. wear)	48		(.010 in. wear)	1-1	14-1	
20	Hobbing	444 B.H.	28	.030	1	42	.030	14	2-1	4-1	
					80			300	4-1	5-1	
					200			1000	1-1	3-1	
					1/3			1			

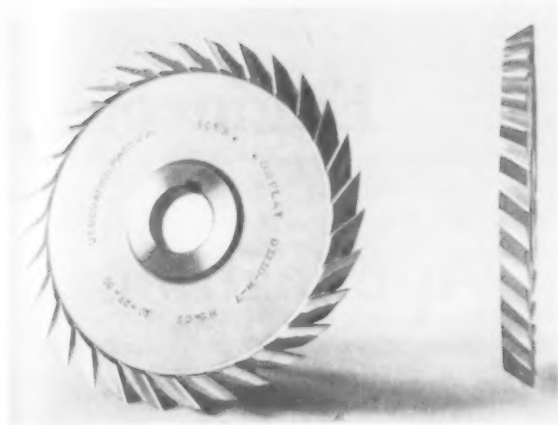


Fig. 3. A 60 deg included angle high rake cutter. Radial rake is 34 deg; axial rake is 10 deg. Operation: milling high speed steel chasers. Speed, 187 sfpm; feed, 20 ipm; chip load, 0.005 in. per tooth. Cutter life averages 1000 pieces per hour.

base and mineral oil is used as a coolant and 1336 chasers were produced before losing the 0.008 to 0.010 in. chamfer on the top of the tooth. This is equal to 350 lineal feet of cutting. They average 1000 chasers per grind, which is five times the number of chasers milled with a standard cutter at conventional speed and 7.5 ipm feed.

On slab milling, Sinawski has used speeds from 180 sfpm on high speed steel to 425 sfpm on low carbon steels when using conventional high speed steel in his cutters. He has run as high as 560 sfpm when using one of the super high speed steels. Radius rake of 30 to 34 deg with about 35 deg axial rake has given very satisfactory results. Chip load up to 0.017 in. per tooth has been used. In slotting and form milling, he uses the same radial rake with 10 to 14 deg axial rake and up to 0.008 in. per tooth chip load.

Most milling at Jones and Lamson has been done with climb cut, but some has been conventional. The chip is formed by a shearing action that produces minimum distortion. With a fixed chip load, the high rake chip comes off as a ribbon of almost the same thickness as the chip load and a length equal to the arc of cut, whereas a conventional cutter produces a heavier compressed curly chip. The chip should show no sign of coloring by generation of heat since the acute sharp cutting edges of the cutter will dull rapidly by abrasion and softening if excessive heat is generated.

Cooling While Sharpening

The problem of eliminating heat from the cutting edge by a suitable coolant when a tool is working is also present when sharpening these keen edged tools. The tooth form presents less volume of metal to absorb the heat generated by the grinding wheel so care must be taken to sharpen without wheel burning.

The shearing action of these high rake cutters is such that less lower per cubic inch of metal removed per minute is used than with conventional cutters. It is necessary, however, to keep the sharp cutting edges cool and this means an efficient coolant, with high wetting and lubricating properties required. There should be sufficient volume to cover the cut, the high speed and rake angle acting to pump or carry the coolant into the cut.

High rake angle cutting has been experimented with at James Hunter Machine Company in North Adams, Massachusetts, using a 6 x $\frac{5}{8}$ x $1\frac{3}{4}$ in. staggered tooth cutter, having 34 deg radial rake, 14 deg axial rake and 10 teeth. This cutter was operated in cold rolled C-1113 screw stock at speeds of 260 and 350 sfpm with various feeds up to 20 ipm, giving chip loads from 0.004 to 0.009 in. per tooth. After milling 150 inches of stock, the edges were honed and C-1020 steel was substituted as a billet. The same range of speeds and feeds was used as above and 225 in. of milling was done.

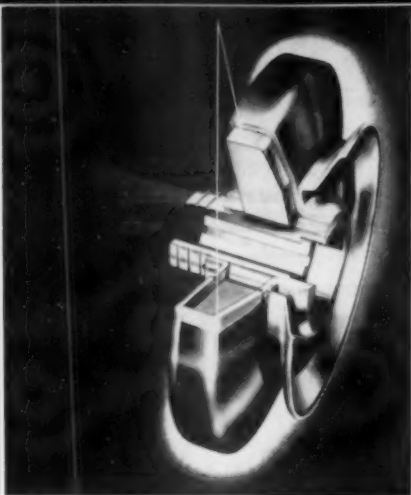
Another customer is using high rake cutters for milling high speed steel at 310 sfpm and 20 ipm feed or a 0.0024 in. chip load. The average pieces per grind increased 50 percent over conventional cutters at a much slower cycle of operation.

Operating a $5\frac{3}{4}$ in. diameter x $2\frac{1}{2}$ in. staggered tooth milling cutter with 35 deg radial rake and 8 deg axial rake, in various cuts in SAE 1020 steel, speeds up to 320 sfpm and 26 ipm feed when cutting $\frac{1}{8}$ in. depth have been satisfactory.

Tests indicate that high rake milling will not work on all materials. Since the cutting edges are very keen and fragile, they will be chipped if run into an abrasive surface, as on the surface of cast iron or the surface of hot rolled steel which is usually scaled. The material should be free of a hard or oxidized surface. Cold drawn steel is satisfactory since the mill scale has been removed by pickling before drawing to size. Best results can be expected from a ground surface. Non-ferrous materials like aluminum, brass and magnesium are ideal for this type cutter.

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Silicone fluid dampens vibration in this high speed rotating unit (see p. 39).

Engineering Applications of Silicones

By I. W. Hutchison

SALES DEVELOPMENT ENGINEER
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SILICONES ARE A CHEMICAL combination of certain inorganic and organic materials. It is common knowledge that such inorganics as glass and quartz possess good dielectric properties and are resistant to high and low temperatures, to chemicals, and to moisture. But glass and quartz are brittle and not easily formed.

As silicones are a chemical combination of both inorganic and organic materials, they possess some of the properties characteristic of both classes of materials. For example, silicones are resistant to temperature extremes, to chemicals and to moisture. They possess good dielectric properties and may be produced in several different physical forms.

There are now about 80 different silicones commercially available. For ease of discussion these may be divided into these four groups: (1) Fluids and oils; (2) Compounds and greases; (3) Resins and varnishes; and (4) Elastomeric materials (silicone rubber).

Applications of Fluids or Oils

The first large-volume peacetime use for silicones was in the rubber industry as mold release agents or die lubricants. The best mold lubricant is that one which gives immediate release even though only a thin film is used. This is especially important in the tire industry, as is illustrated in

Fig. 1, which shows a tire mold being sprayed with a silicone release agent. Silicone release agents are also used as lubricants for die casting zinc and aluminum.

In addition to their release property silicone fluids also possess the ability to maintain a rela-

Fig. 1. Use of silicone as a lubricant speeds up tire production by providing for faster release from the mold.



tively constant viscosity over a wide range of temperatures. This makes them suitable as hydraulic oils and damping media. On p. 38 is a device made by the Houdaille-Hershey Corporation. This unit reduces the torsional vibrations of automobile and Diesel engine crankshafts. It consists of an inner flywheel, which rotates at engine speed, and a hollow disk housing attached to the end of the crankshaft. The flywheel is separated from the housing by a thin film of a high-viscosity silicone fluid. When critical speeds that cause torsional vibration are reached, the flywheel tends to continue to rotate at a constant speed and the vibrations are damped by the viscous drag of the silicone fluid between the flywheel and the housing. This is an old principle but one which could not be adapted to oils exhibiting even moderate changes of viscosity with temperature.

Bearing Lubricants

Silicone fluids or oils are also used as bearing lubricants. In the case of one oil furnace fan motor, the bearings of this well engineered unit are oil-lubricated and customers were advised to change oil only once a year. The customer did not do so, with the result that in two or three years the oil was badly oxidized and carbonized and the entire unit had to be replaced. The company's engineers had been searching for a solution to the problem, but it was not until they tested a silicone fluid that they found the answer. Accelerated breakdown tests indicated that one application of silicone fluid would provide adequate lubrication for at least four to five years. Lifetime field tests confirmed these results.

Fig. 2. A silicone grease cut maintenance on this core oven conveyor, which is exposed during operation to temperatures up to 700 deg F.



Silicone fluids are also used to prevent foaming in petroleum oils. This is a serious problem with both straight cutting oils and with the soluble oils frequently used to lubricate and cool high-speed drills, and other cutting tools. Most remarkable about this application is the concentration required; only one part of silicone fluid per million parts of oil is sufficient.

Applications of Compounds and Greases

Chief among the applications for the silicone compounds are those resulting from the release properties characteristic of these semi-solid materials. These inert compounds are used wherever a release agent is required in the rubber, plastics and plywood industries. Applied from a solvent dispersion, one silicone compound is a most effective agent in the Croning or "shell" process for casting nonferrous parts. Other silicone compounds are used as waterproof dielectric seals for ignition systems, electrical control circuits, and radio and radar equipment.

Good lubricity combined with stability at high temperatures and excellent oxidation resistance are the reasons why silicone greases are considered essential in a wide variety of industrial applications. These inert greases are used to lubricate ball bearings operating at high and low temperatures and such low-speed, high-temperature equipment as conveyor bearings, oven machinery and pumps handling hot liquids.

Fig. 2 shows a portion of one of several core oven conveyors operated by the Ford Motor Company. These ovens operate sixteen hours a day, five days a week, at a peak heat of 700 deg F. The 7200 trolley bearings in the systems are exposed to this heat for two and one-half hours out of every four hours. Even with automatic oiling, the bearings froze, wheels were flattened, and production was interrupted. About four years ago, Ford switched to a silicone grease for the trolley bearings. Results were immediate. The conveyor systems start easily, run continuously and require considerably less power to operate. Replacement and maintenance costs are greatly reduced and the bearings exposed to 700 deg F. heat are relubricated only once a week.

Applications of Resins and Varnishes

This group of silicones, more than any other, has led to the commercial development of silicones in this country.

Disregarding the metal portion, there are only two constituents which determine how hot a motor can be run. Before glass cloth became available, the spacing materials (formerly paper or cotton) and the binders had about the same order of heat resistance. But with the development of glass fabrics, the resin and varnish binders became the inherent limitation.

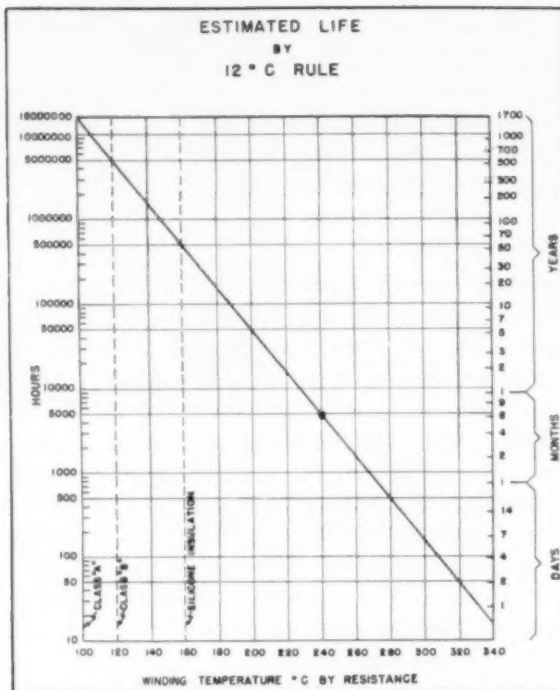


Fig. 3. Insulation life in an electric motor at various operating temperatures using silicone.

It was obvious that if the additional heat and moisture resistance of the glass materials was to be fully utilized, binders of equivalent heat stability were necessary. The silicone resins and varnishes ultimately developed possess the heat stability necessary for full utilization of glass electrical insulating components.

Electrical engineers have a unique way of expressing anticipated life of a motor. They have a rule that, for each 12 deg C temperature rise, the life of the insulation can be expected to be cut in half. Fig. 3 demonstrates what happened when they applied this rule to silicone insulation. It is evident that, according to such a rule, silicone insulation has a much longer life expectancy than any ordinary electrical insulation.

Life Greatly Extended

High temperatures in motors can be caused either by overloads or by ambient conditions. One such problem involved motors driving coilers which take red-hot steel strip from an 80-inch mill and roll it into coils. At the same time the strip is cooled with water. Thus these motors are exposed to water, steam, high ambient temperatures, and overloads. The average life of motors wound with Class B insulation was two months. Silicone-insulated motors are still in service after 14 months.

In addition to increased service life there are other advantages to be gained by a more heat-stable electrical insulation such as silicone insulation. Design engineers may now build smaller and more compact motors. The motors may heat up without

injury to the silicone insulation because it easily withstands operating temperatures of 200 to 250 deg C. Smaller units mean savings in weight and space which are often very important considerations. Comparing a standard Class A motor and a silicon-insulated motor, both rated at 5 hp, the latter weighs only 60 percent as much as the standard motor, and occupies much less space.

As another example, one company needed more pumping capacity than they could get out of a line of twelve 50 and 60-hp motors; but twelve new 75-hp Class A motors would have cost \$25,000. Instead of installing new motors, the old motors were rewound with silicone insulation at a cost of only \$7,500. The silicone-insulated motors are rated at 75 hp. Thus the desired additional pumping capacity obtained at a saving of \$17,500.

Other silicone resins are used as vehicles for high-temperature paints and enamels. Paint deteriorates rapidly on hot surfaces such as smokestacks, mufflers, and exhaust cylinders. Also, white enamels do not stay white long; they slowly yellow with age. Silicone resins, with their inherent stability to heat and oxidation, have solved many such troublesome problems. These resins require baking to develop their properties, hence silicone paints are not yet available for exteriors of dwellings, but should become available in the future.

Applications of Silicone Rubber

The fourth group is silicone rubber, which is able to withstand temperatures of 500 deg F and yet remain flexible at temperatures of minus 100 deg F.

The material is available in two forms, one a thick heavy paste, the other a stock or "crepe". The pastes are used to coat glass cloth and as calking and potting compounds. The stocks or "crepes" can be molded, extruded, laminated, calendered or sheeted to form gaskets, seals, diaphragms, hose and mechanical parts.

There are many applications for a material possessing these properties. The Convair B-36, a huge aircraft having a service ceiling above 40,000 feet and a range of more than 10,000 miles carrying a 10,000 pound load halfway, may take off in the tropics and climb into air temperatures of minus 100 deg F. Parts of it operate continuously at plus 450 deg F. To meet such severe service, silicone rubber is used to seal the heating and anti-icing systems, bomb bays, limit switches and rocker arm housings.

Industry has many applications which require gaskets and seals to remain flexible at high temperature. Quite often it is necessary to make elaborate design changes to put the gasket location away from the source of heat. Silicone rubber provides a flexible gasket which makes possible simpler and less expensive designs.

Reduction of Vibration and Sound Transmission with Rubber Mountings

By Arnold Pfenninger, Jr.

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THE INSTALLATION of machinery frequently involves the problem of eliminating or minimizing the transmission of vibration between the equipment and its supporting foundation. One way of accomplishing this is by solidly attaching the equipment to a foundation of such mass and rigidity that vibrational motion is prevented. A generally more satisfactory method is to provide a resilient supporting structure of such design that vibrational disturbances arising from the operation of the equipment are effectively isolated from its foundation.

The resilient material must satisfy a number of requirements to be considered satisfactory for the fabrication of vibration isolators. These are: Adaptability to wide range of design requirements, low cost, limited space requirements, satisfactory age life, resistance to mechanical injury, a high degree of elasticity and reproducibility in manufacturing quantities. Certain specially compounded grades of rubber satisfy the above requirements and lend themselves to a wide range of design conditions. These compounds are designed for maximum elasticity with a minimum of hysteresis or internal friction. They exhibit excellent compression set characteristics in that the permanent deformation under load does not become so excessive as to affect the normal operation of the mount during its lifetime.

Table I gives a comparison of physical properties for natural and synthetic rubber compounds having a Shore A durometer hardness of 50.

Although it is not as good as natural rubber, neoprene, because of its excellent oil resistance, is

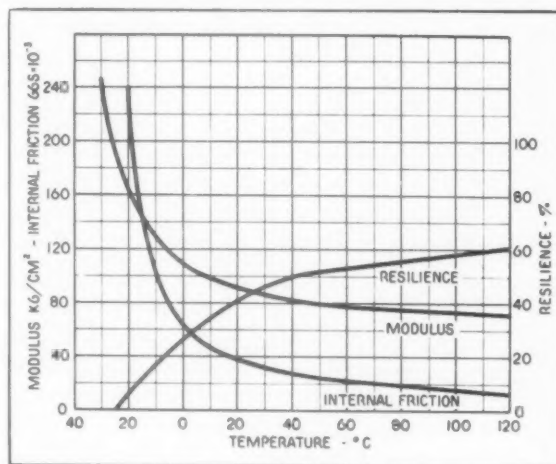
used to advantage where contact with oils and greases cannot be avoided.

In Fig. 1 the data of Stambough^{2*} used to show the effect of temperature on some of the dynamic properties of natural rubber. Resilience increases with temperature, whereas modulus and internal friction decrease with temperature. The properties of neoprene and other synthetic rubbers are affected similarly by temperature.

The dynamic behavior of rubber compounds can usually be estimated with sufficient accuracy from static properties. It is important, however, to keep in mind the following facts which tend to produce a difference between static and dynamic properties.

1. The dynamic modulus of elasticity is slightly higher than the static modulus. It increases with static strain for rubber in compression, but decreases with static strain for rubber in shear. The ratio of dynamic to static

Fig. 1. Effect of temperature on dynamic properties of natural rubber (frequency 60 cps).



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TABLE 1—PHYSICAL PROPERTIES OF 50 DUROMETER NATURAL AND SYNTHETIC RUBBER COMPOUNDS

Elastomeric Polymer	Natural Rubber	Neoprene	Butadiene Acrylonitrile	Butadiene Styrene
Physical Properties				
Tensile Strength, psi	3,600	3,200	1,950	2,000
Ultimate Elongation Percent	660	650	450	650
Compression Set ASTM D395-49 T Method C, 70 hr. at 212 deg F	18	35	42	35
Dynamic Modulus psi at 70 deg F	110	200	400	250
Internal Friction Poises at 70 deg F	3.2	12	50	11
Oil Resistance	Poor	Excellent	Excellent	Poor
Ozone Resistance	Poor	Good	Poor	Poor
Heat Aging	Fair to Good	Good	Good	Good
Adhesion to Metal	Excellent	Excellent	Fair	Fair
Useful Temperature Range, deg F	-65 — +160	-40 — +225	-30 — +250	

modulus also increases somewhat with the hardness of the rubber compound and slightly with frequency.²

- Internal friction increases with static strain and decreases with frequency.²

The design of a satisfactory mounting installation involves the consideration of certain fundamental physical principles. A resilient supporting system possesses a definite natural frequency of vibration which is dependent upon its mass and resilience of its spring support. This may be expressed by the equation:

$$f_n = \frac{1}{120} \sqrt{\frac{k}{M}}$$

Where

f_n = natural frequency in cycles per minute

k = stiffness of the spring support in pounds per inch of deflection

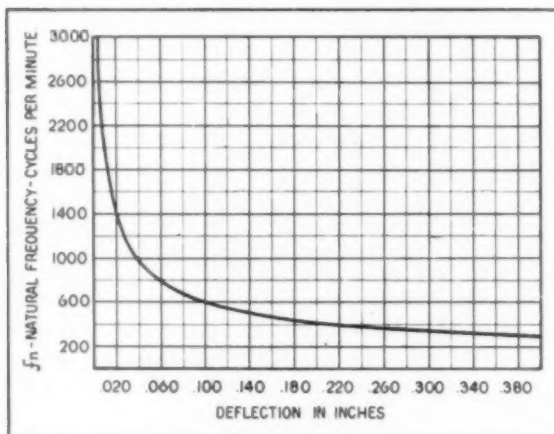
M = supported mass in lb sec²/in.

The frequency may also be expressed as a fraction of the static deflection of the mount under the weight of the supported body by means of the substitution

$$k = \frac{Mg}{d}$$

* Numbers refer to bibliography at end of article.

Fig. 2. Natural frequency as a fraction of static reflection.



where:

g = acceleration due to gravity in./sec²

d = static deflection in inches.

Thus:

$$f = 188 \sqrt{\frac{1}{d}}$$

This relation is shown graphically in Fig. 2, where deflection is plotted against natural frequency. The disturbing frequency, or frequencies, of forced vibration are generally fixed or are variable over a limited range for a given installation. Their origin is in the periodic dynamically unbalanced motion of machine elements or magnetic disturbances of electrical equipment. If a mechanism is supported on resilient mountings so that the natural frequency is much lower than the forced frequency of vibration, then a considerable portion of the vibrational energy of the system will be isolated by the mountings. The ratio of forced frequency to natural frequency is called the insulation ratio, and the greater its value the higher the degree of isolation achieved. The effectiveness of the elastic suspension may be expressed more clearly in terms of its transmissibility which is designed as the ratio of the disturbance produced on the foundation when a spring system is used to that when the vibrating body is rigidly attached. The transmissibility of a resiliently supported vibrating body can be expressed in terms of the insulation ratio by means of the following relation:

$$\epsilon = \frac{1}{1-R^2}$$

Where

ϵ = transmissibility

R = insulation ratio.

In Fig. 3 transmissibility is plotted versus insulation ratio. It is seen that a resonant condition occurs at $R = 1$ where the natural frequency is equal to the forced frequency of vibration. At this point the forces on the system and displacement amplitudes become infinite in the case of a perfect spring system. In practice, however, all spring materials possess a certain amount of internal friction which limits ϵ to a finite value at resonance. Good design requires that the natural frequency of the system be well below any of the exciting frequencies, since at resonance, or frequencies near resonance, forces set up may be so great as to ruin equipment and its supporting structure. In order to achieve satisfactory vibration isolation, the transmissibility must be considerably less than unity. A value of 1/5, which corresponds to 80 percent isolation, is considered to be a maximum for a satisfactory operation. It has been shown that in ordinary cases of sound isolation for an elastic system to be really effective, the transmissibility must

be at least as small as $1/30$, or equivalent to 99 percent isolation. It is seen from Fig. 3 that if the insulation ratio is less than unity, the transmissibility is greater than unity and the suspension is worse than useless.

The foregoing discussion has been based on the consideration of one degree of freedom. However, a resilient mounting system may have many modes of motion, each having its own natural frequency. In designing a mounting system, care must be taken that the highest natural frequency is sufficiently below the lowest exciting frequency to insure good isolation, since in most installations exciting forces may cause motion in more than one mode. Examination of a typical mounting system will show that motion may take place in several ways, i.e., translation in the horizontal and vertical directions as well as torsional and tilting. We must also consider the fact that in practical installations there is frequently more than one disturbing frequency. For example, a piece of equipment driven by an a-c motor may exhibit one or more forced frequencies due to its component mechanisms as well as the 120 cycle hum frequency due to motor operation.

When designing a suspension, it is important to space the individual mountings so that each takes an approximately equal share of the total load. The center of gravity should be kept as close to the mounting plane as possible and centralized within the configuration of the mountings. In the ideal system a focusing type suspension is used where the point of virtual suspension is made as close to the center of gravity as possible. When the point of virtual suspension coincides with the center of gravity, any translational or rotational force applied to the system will result in linear motion or rotation about the center of gravity without coupling.

This type of suspension is used to particular advantage in mounting aircraft engines where the mounting plane is vertical and there is a relatively large overhung weight due to the engine and propeller combination. In cases where it is necessary to mount equipment on a plane considerably below its center of gravity, it is usually advisable to provide additional resilient supports at some point above the center of gravity in order to increase the stability of the system. Typical examples of such cases are the installation of control panels and cabinets containing electronic equipment on shipboard where the base is usually supported by four isolators with two or more additional isolators securing the top back of the apparatus to a bulkhead or supporting bracket.

Mountings are usually designed to use the rubber in compression, shear, torsion or a combination of these ways. For practical purposes the volume compressibility of rubber may be considered to be essentially zero. Thus any distortion which takes

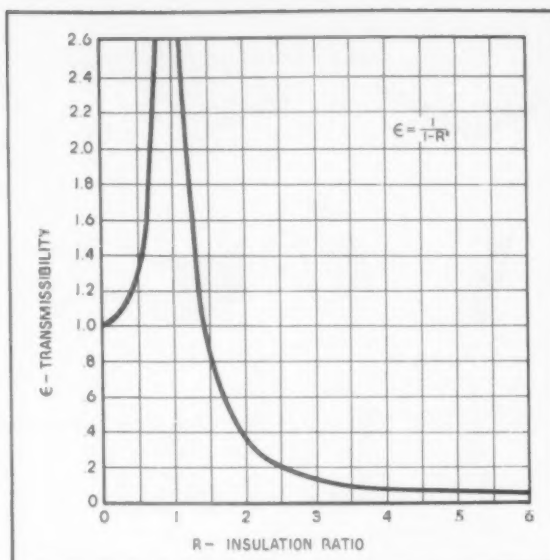


Fig. 3. Variation of transmissibility with insulation ratio.

place must be accompanied by a bulging or displacement of the rubber volume.

The behavior of rubber in compression has been approximated by Keys¹ who states that for square slabs of the same thickness under equal compressive stresses, the reflection varies as the inverse of the length of side, and that where height is small compared with the base dimensions, deflection is proportional to the height of a column of constant cross-section.

The apparent compressive modulus varies with the rubber compound, extent of deflection, shape and size of the mount. It also makes a considerable difference whether the load carrying surfaces are bonded to metal or are free to slip. The behavior of these variables is such that it is necessary to use empirical relationships and graphs to extend test data for design purposes.

Heavy Equipment Designs

Rubber pads of the type shown in Figs. 4a and 4b, are usually employed for supporting heavy equipment. They are most effective at high frequencies and for sound isolation since deflections must be kept to comparatively small values. The waffle construction shown in *b* illustrates one method of obtaining a softer action without increasing pad thickness. Pad mountings are available in sheet form and are cut to size to meet installation requirements. Greater stiffness is obtained by increasing the pad area. A softer action can be obtained by stacking two or more pads using interleaving steel plates in the case of the waffle or similar type constructions. If the base or feet of the equipment are not flat or of sufficient size, steel plates should be used to provide uniform load distribution. The deflection under static load should be limited to less

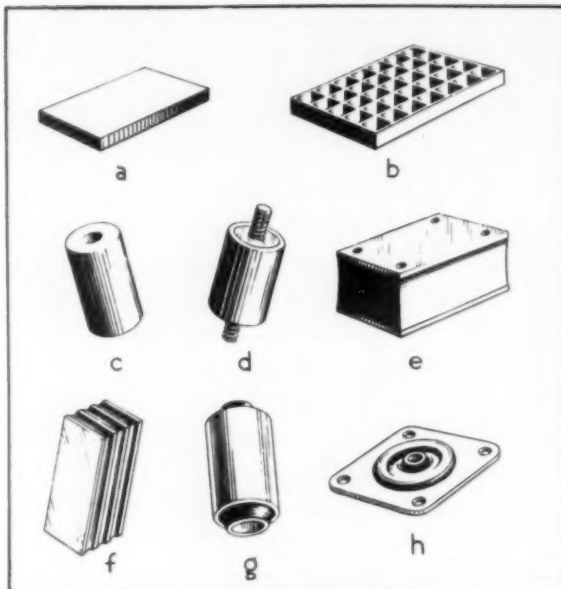


Fig. 4. Some basic types of rubber mountings, including pad, grid, sandwich and designs for compression or shear resistance.

than 20 percent of the free height to minimize creep. Neoprene pads should be used if exposure to oil and grease is involved.

The bushing, *c*, is one of the earliest and simplest types of mounting. In the usual method of application, two bushings are used for each mounting. These are placed on either side of holes in the mounting brackets or feet. A bolt passed through the assembly secures it to a supporting base. Mountings of this sort cost but a few cents apiece and are employed as vibration isolators and shock mountings where requirements are not critical but low cost is important. They are commonly used to support equipment in shipping crates.

Types shown in *d* and *e* are suitable for use in compression or in a combination of compression and shear. Metal plates equipped with studs or tapped holes are bonded to the rubber. Because of high stresses at the outside edges of the rubber to metal bond, the shear load rating is usually limited to about 25 percent of the rating in compression. The maximum recommended compressive deflection is 15-20 percent of the free height. By changing the shape of the cross-section and its ratio to height, the spring rates in the various directions of motion can be varied in their relation to one another.

Shear Type Mountings

For mountings of comparable size, shear loading will give much higher deflections since the modulus of elasticity in shear is approximately $\frac{1}{6}$ that in compression. The elastic behavior of rubber in torsion is effectively the same as for the shear case. The most common shear type mountings consist of bonded rubber metal sandwiches. In Fig. 4, *f* and *g*

represent rectangular and cylindrical designs respectively. The ratio of sandwich thickness to length in the direction of load application should be kept small, preferably less than $\frac{1}{4}$ for the sake of stability. This tends to limit deflection. However, greater deflections can be obtained without impairing stability by using the multi-layer construction of *f*, which consists, essentially, of a series of properly proportioned single layer sandwiches. Shear sandwiches are often preloaded in compression and the ends are made oblique so that additional compressive stresses are introduced during deflection. This relieves stresses on the rubber to metal bond and permits larger deflections. The effect of compression on the shear spring rate is very slight.

The large deflections obtainable with shear type mountings make them particularly suitable for the isolation of low frequency vibrations and for absorbing impact shock.

Tubular types, similar in appearance to *g*, are also used as torsion springs.

A typical AN series plate type mounting of Lord design is shown in *h*. It illustrates the simple manner in which it is possible to combine shear loading for vibration isolation with snubbing in compression to absorb shock and limit travel in the axial direction. Variations of this design are widely used in aircraft and on naval vessels for mounting delicate electronic equipment.

Wide Variation Possible

The designs that have been described are simple ones. They do, however, illustrate the basic ways in which rubber can be employed as a vibration isolator. The facts that rubber can be bonded to metal and molded to shape make possible an infinite number of design variations. A few of the important features which can be readily incorporated into rubber mountings are:

1. Resilient snubbing beyond normal deflection.
2. Non-linear load-deflection curves to limit resonance effects when critical speeds are encountered in the operation of equipment.
3. The design of metal parts such that the equipment is held captive in the event of rubber failure.

The size of rubber mountings is limited primarily by the fact that it is necessary to keep thicknesses under two inches to obtain a satisfactory cure in the center of the piece without involving excessive vulcanization time or over-cure of the surface rubber.

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Manufacturing Applications of Liquid Impact Blasting

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THE APPLICATION OF LIQUID impact blasting equipment is as broad as industry itself. In developmental experimenting, specimen parts are being blasted which are so large they must be handled with a crane; other parts are so small they must be handled with tweezers.

Perhaps a classic example is the wet blasting of Bibles for a publisher and binder. The purpose was to blast the edges of the pages to improve the bonding of gold leaf. At first thought, this seemed highly impractical, but the publisher brought these books to us with the pages clamped together under about 400 psi pressure, the edges having been previously sanded. The blasting proved very satisfactory and the water did not tend to wet the edges of the paper under this condition.

The usefulness of liquid impact blasting to tool engineers is based on three fundamentals: (1) Improved quality of product; (2) Reduced cost through labor saving; (3) Increased production.

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It is useful to review the general methods of which any abrasive impact system works:

1. Suction Feed. The blast gun connects with two feed lines, one for compressed air and one for abrasive (see Fig. 1). This gun is very similar in principle to an ejector pump. Compressed air passing through the nozzle creates a partial vacuum, which lifts the abrasive to the gun and then drives it forward at high velocity.

2. Direct Pressure. In this type of unit the abrasive is contained in a pressure vessel and forced to the blast gun by compressed air, usually at 80 to 90 psi.

3. Centrifugal (Airless) Blasting. In equipment of this type, the abrasive is fed through the center of a rotating paddle wheel and is thrown by centrifugal force along the vanes at high velocity (see Fig. 2).

Each of the above methods has its own best applications. At present, most liquid blasting uses the suction feed method or a modification of this

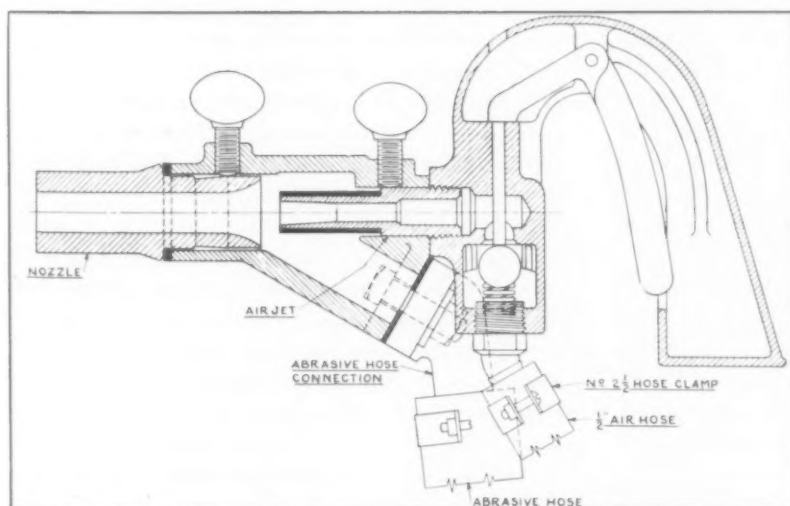


Fig. 1. Suction feed blast gun, in which compressed air passing through nozzle creates partial vacuum. Abrasive is lifted into gun and ejected at high velocity.

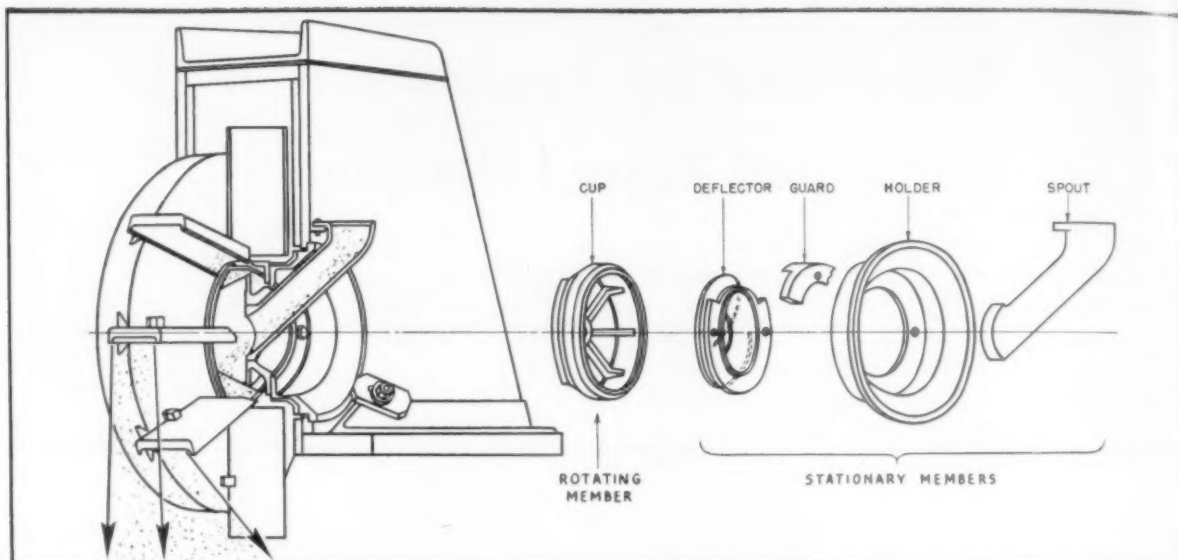


Fig. 2. Airless blasting, where abrasive is picked up by centrifugal force of rotating wheel and thrown along vanes at high velocity.

method where the abrasive is fed to the blast gun at low pressure. The latter offers greater blast efficiency since all the energy of the compressed air is used in propelling the abrasive and none of it is consumed in lifting the abrasive to the blast gun.

Nature and Uses of the Process

Liquid blasting is a modified form of impact blasting whereby abrasive is suspended in a liquid, agitated to maintain suspension, and propelled through the blast gun by means of compressed air or other gas. Since the abrasive is suspended in a liquid (usually water plus a corrosion inhibitor), there is no limit to the fineness of the particles that can be used, but they are generally in the talcum powder range and finer.

This contrasts with the definite particle size control needed in a dry blast system because (1) Fine dry abrasives tend to pack tightly and flow unevenly; (2) Fine dry abrasives naturally create dust and an effective control provision is required; and (3) Surface finish produced by a fine dry abrasive is not as smooth as that produced by the same abrasive blasted in suspension with water using same pressure and volume.

Liquid blasting is most generally adaptable to the following uses:

1. Removing and blending directional grinding lines.
2. Removing hardening oxides and discolorations.
3. Improving lubrication retention.
4. Preparing surfaces for electro-plating.
5. Mold and die maintenance.
6. Improving cutting tool life and appearance.
7. Deburring.
3. General maintenance cleaning.

The above uses may be profitably considered from the point of view of two basic classes: Tool room use as an aid to production, and use for production line.

Tool Room Applications

For this type of work, a manually operated cabinet is recommended, since the work loads are variable. The chief interest is in producing good finishes while eliminating tedious hand work.

As a specific example, consider a die-casting die. A die of this type will be well fitted to most of the applications listed. Many people in the die casting field have been using liquid blasting equipment successfully for years.

1. In the making of a die cavity or core, it is well to do as much polishing as possible before hardening, then liquid blast to blend and remove the grinding and directional polishing lines left on the surface. By blasting, the finish can be considerably improved. It is often necessary for the material being fabricated by the die-casting die to travel over the die surface in a direction perpendicular to the direction in which this surface was machined and polished. By improving the surface finish and producing a non-directional surface the resistance to such flow is reduced. Also, by liquid blasting, it is possible to reach many places difficult to reach in hand polishing.

It is important to remember that the finish obtained by liquid blasting is a function of the finish *before* blasting. Liquid blasting will not make a rough ground piece smooth enough to do the work of a finish ground piece. A good die can be made better, but little to improve a badly finished, malfunctioning die. Also, liquid blasting should not be thought of as a tool for producing a given dimension. In other words, a part should be fin-

ished to dimension before blasting, then blasted with an abrasive fine enough to hold that dimension.

2. After hardening, the die can be blasted to remove the oxides which develop. In one reported case a die casting company required approximately sixteen man hours of labor to hand polish sixteen small inserts. Using liquid blasting, the processing time for these same pieces was reduced to less than one hour. The inserts were used in making a small serrated knob for a home appliance. The cavity was about $\frac{3}{4}$ in. deep, $\frac{3}{8}$ in. diameter at the bottom and tapered to about $\frac{1}{2}$ in. diameter at the top. The many serrated grooves running from top to bottom made this piece difficult to polish by hand. The report further stated that the die produced good hardware finished parts almost immediately, whereas, a normal hand polished cavity of this type required considerable break-in time before producing good parts.

3. Surfaces which have been liquid blasted with fine abrasive contain many microscopic wells. A surface of this type retains lubrication very satisfactorily. There is reason to believe that drawing dies treated in this manner will hold the drawing compounds more satisfactorily and thus better resist galling and scoring.

4. Many reports have been received on the part liquid blasting has played in improving the quality of plating. Reported improvements include: (a) Removal of grinding fuzz in order that plating adheres only to base metal; (b) Removal of small bits of smudge which may cause gassing in the plating tank and result in a bad plating job; (c) Provision of smooth plating build-up around corners and sharp edges; (d) Provision of same surface conditioning effects as mentioned previously.

5. Liquid blasting has a major application in the maintenance of dies and molds after they are placed in service. This is an especially critical item with manufacturers who use molds and dies which operate at high temperature and require periodic maintenance, such as die-casting dies, rubber molds, glass molds, forging dies and others. It is useless to place highly polished surfaces on a die or mold if they can not be maintained in cleaning. Liquid blasting has been invaluable in answering this requirement. Due to the fine abrasive used, repeated cleanings can be accomplished with a minimum of metal removal and at the same time leave a surface on the die or mold equivalent to the original.

In addition to the previously cited advantages of cleaning die-casting dies, liquid blasting provides rapid cleaning with semi-skilled labor, reduces break-in time, eliminates disassembly in many cases, and permits more thorough parts inspection after cleaning.

6. The use of liquid blasting as a means of finishing cutting tools is a subject of considerable con-

troversy. Liquid blasting is not a "cure all"; however, many companies have found that production cutters blasted after grinding have shown considerable increase in tool life.

Machinists will agree that if they hand-stone a cutter after grinding, it will last longer. It is believed that in the main approximately the same thing is accomplished when liquid blasting a cutter that the machinist does when he hand-stones it. The main difference is that it is impractical for a machinist to hand-stone a complicated cutter such as a hob or a broach, due to the time consumed, while it is an easy and quick job to liquid blast cutters of this type. Reliable data on the subject of increased tool life can only be gained by statistical evidence.

Liquid Blasting on the Production Line

In some cases, manually-operated equipment is sufficient to meet production requirement, but many times it is necessary to design automatic or semi-automatic machines. This has recently been done for one of the automotive manufacturers who will use liquid blasting to remove carburizing smudge from ring and pinion gears. This will require four rotary indexing table machines, each finishing in the neighborhood of 700 pieces per hour.

Also, there have been designed and built several inclined, parallel roll machines for processing round work of various types. Several of these were installed by textile machine manufacturers for improving the finish on fluted spinning rolls. After the rolls leave the liquid blast machine, they are checked by passing absorbent cotton over the surface of the roll. There can be no pickup of cotton fiber on the finished surface. One manufacturer of these rolls stated that he would eliminate five automatic honing and hand-stoning operations with the use of liquid blasting. This same machine has received very favorable consideration by the automotive manufacturers, who have the problem of processing automatic transmission control valve plungers. This type of equipment is being considered for the removal of the feather edges which are left after centerless grinding.

Several other automatic table machines have been built for the processing of television parts, and liquid blast tumbling barrels are available for blasting small parts by a batch handling method.

It must be remembered that liquid impact blasting deals with the application of very fine abrasive material. It is, in a sense, a "finish grinder," and is primarily intended for processing *finished*, not raw, material. It would be as inefficient to use this finishing method for rough work as it would be to grind a rough casting to finish size when intermediate turning machines are available to do the job economically.

Optimum Use of Power Presses

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FUNDAMENTALLY, A POWER PRESS performs its work by exerting pressure against a material placed between a die mounted on the bed of the press and a punch attached to the moving slide. The work, usually expressed in inch-tons, is consequently equal to the pressure which the slide is required to exert multiplied by the length of the actual working movement of the punch (that is, the slide) while performing the operation.

Press Drives

In mechanical presses this work is obtained by the expenditure of the energy of the flywheel which results in its slow-down during the work period of the slide. The permissible slow-down is about 7 to 10 percent in presses having flywheels mounted directly on the mainshaft (crankshaft) of the presses, and 10 to 20 percent in geared presses having a train of gears between the mainshaft and the drive (flywheel) shafts. A larger slow-down for geared presses is allowed because the driving motor requires more time between the working strokes of the slide to bring the flywheel to its normal speed.

Under such conditions the amount of flywheel energy available for press work may be considered as a fixed quantity if continuous duty, without any danger of stalling the press, is expected. Total energy depends upon the design of the flywheel, its rim weight, the speed of its rotation, and the gear ratio between the drive and the crankshaft or mainshaft.

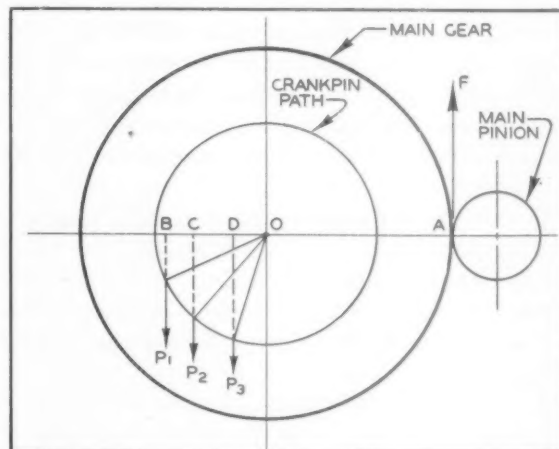
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In each mechanical power press, where the expendable flywheel energy is a fixed quantity, it may be easily shown that the press can exert more pressure near the bottom of the slide stroke than near its midstroke.

Assume a mechanical press of a geared type, and disregard the influence of the length of the oscillating part of the pitman (connection), of its ratio to the stroke of the press, of the pressure angle between the gear teeth of the main (bull) gear and the main pinion, of all friction losses, and so forth.

The simplified picture of the forces acting on the crankshaft or the eccentric of the press will then be as shown in Fig. 1.

Fig. 1. Below are shown in diagrammatic form the forces acting on the crankshaft or the eccentric of a mechanical press.



since $OB > OC > OD$

$$F \times OA = P_1 \times OB = P_2 \times OC = P_3 \times OD$$

this equation can be only true if

$$P_1 < P_2 < P_3$$

This indicates that the nearer the slide is to the bed of the press the greater is the pressure it exerts, the least pressure being at the midstroke. Presses are, therefore, designed, built and rated in accordance with the maximum pressure they are expected to exert near the bottom of the stroke of their slide.

This explains why a press which is successfully used for such short-stroke operations, as blanking, piercing and coining can easily be stalled and be unsuitable for work with a continuous pull, starting high above the bed of the press, as in drawing and ironing work. It is important to the user to know the bottom (rated) and the midstroke pressure capacities of his press.

Rated Pressure Capacity of Mechanical Presses

The bottom (rated) pressure capacity in a crankshaft press is based on the torsional and bending capacity of its crankshaft, which depends upon the

diameter of the crankshaft at the main bearings, on the construction of the crankshaft (eccentric or crankpin type) and on the kind of steel used and its heat treatment.

Table I gives the bottom capacity of mechanical power presses equipped with 0.45 - 0.50 percent carbon steel forged and heat-treated crankshafts having main bearings at each side of their cranks.

The pressure capacities of presses with crankshafts up to 7-in. diameter can easily be memorized by the accepted formula

$$\text{Pressure capacity} = 31\frac{1}{2}d^2$$

where d = diameter of the crankshaft at main bearings.

For the streamlined presses with crankshafts and mainpins all covered up, and especially for gear-eccentric presses, there is not such a plain indicator for press capacity as the diameter of the crankshaft at the main bearings in crankshaft presses.

The largest press-using industry, the automobile industry, brought this matter before the automotive Joint Industry Conference on Press Room Standards, which adopted the standard marking system now coming into wide use by the press builders. In this marking system each press carries the press builder's name, type (action) of press with the number of press connections (suspension points), tonnage (rated capacity) and the area of the press bed (right to left by front to back). For example, a marking S4-200-84-54 denotes a single action or slide press of four point suspension, two hundred tons capacity with a bed 84 x 54 in. (R-L X F-B). A "double" action or slide press will have the letter *D* instead of *S*.

TABLE I—RATED CAPACITIES, OR BOTTOM-SLIDE PRESSURES, IN TONS, OR CRANKSHAFT PRESSES

Diameter, in., of Crankshaft or of Tie Rods	Crankpin Type Suspension Points (Crank)			End Pin Type	Tie Rod Frame Strength
	one°	two°	four		
1	3	1	—	—	—
1 1/8	4	—	—	3	—
1 1/4	4.5	—	—	—	—
1 3/8	6	—	—	—	—
1 1/2	7.5	—	—	4 1/2	—
1 5/8	9	—	—	—	—
1 3/4	10.5	—	—	7 1/2	—
1 7/8	12	—	—	—	—
2	14	—	—	10 1/2	46
2 1/8	16	—	—	—	—
2 1/4	18	—	—	14	60
2 1/2	22	22	—	18	74
2 3/4	24	—	—	—	—
2 5/8	26.5	26.5	—	22	92
2 3/4	28	—	—	—	—
3	31.5	31.5	—	26 1/2	112
3 1/4	37	—	—	—	134
3 3/8	40	—	—	37	158
3 1/2	43	43	—	—	184
3 3/4	50	—	—	43	212
4	56	56	—	—	—
4 1/4	65	—	—	50	274
4 1/2	71	71	—	—	—
4 3/4	80	—	—	—	—
5	88	88	140	71	343
5 1/2	106	106	170	86	421
6	126	126	200	106	506
6 1/2	150	150	240	—	599
7	180	180	300	120	700
7 1/2	215	215	375	—	809
8	255	255	450	—	926
9	345	345	600	—	1182
10	440	450	800	—	1471
11	545	650	1050	—	1790
12	665	900	1350	—	2141
13	790	1150	—	—	—
14	920	1400	—	—	—
15	1060	1700	—	—	—
16	—	2000	—	—	—
17	1300	2300	—	—	—
18	1500	2700	—	—	—
20	1950	—	—	—	—

*Pressure capacity figures are given for all single-action presses and for the inner slide of double-action presses. Crankshafts are measured at main bearings. These pressure capacities are based on standards adopted by the Committee on Metalworking Machinery of the Technical Committee on Standard Commodity Classification, Division of Statistical Standards, Bureau of Budget, Washington, D. C.

Fig. 2. Condition of forces in a mechanical power press when the slide is above the bed of the press.

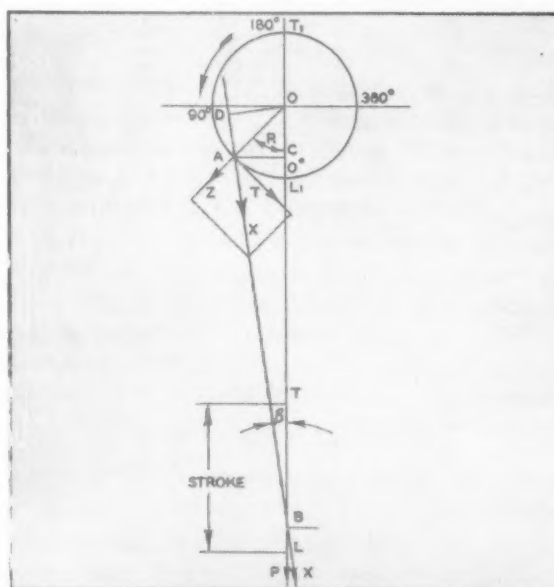


Fig. 2 presents the condition of forces in a mechanical power press with the slide above the bed of the press. The circle represents the path of the center of the crankpin or of the eccentric.

S = stroke of the press slide, in.

r = radius of the center of the crankpin (throw) or the eccentricity of the eccentric, in.

l = length of the oscillating part of the press connection (pitman), in.

$\frac{r}{l}$ = pitman ratio K

$\alpha = \angle AOB$ = angle of the turn of the crankpin or of the eccentric from the lowest bottom point position of the slide;

$\beta = \angle ABO$ = angle formed by the axis of the pitman with that of the slide;

$P\alpha$ = pressure exerted by the slide when the crankpin or eccentric is at the point A , tons

$M\alpha$ = torsional moment on the crankpin or eccentric at the point A , in.-tons

X = force transmitted by the pitman from the crankpin or eccentric to the slide.

At the point B the force X in accordance with the parallelogram law of mechanics can be considered as a resultant of two forces; a vertical force P and a horizontal force. The vertical force P will be equal to the pressure exerted by the slide at the point B of its stroke while the horizontal force presses the slide against its gibs in the press frame. Force $P\alpha$ will then be

$$P\alpha = X \cos \beta$$

$$X = \frac{P\alpha}{\cos \beta}$$

The force $P\alpha$ can be expressed in terms of the torsional moment of the forces acting on the crankpin or eccentric and of the angular position of the crankpin or eccentric in the press:

$$M\alpha = X \times OD \quad (1)$$

where OD is a perpendicular distance from the center of the crankpin or eccentric to the direction line of force X , that is, to the axis of the pitman.

At the point A the force X may be accepted as being a resultant of forces T and Z . The force T is tangential to the circle described by the radius of the crankpin or of the eccentric, and the force Z is acting along this radius.

For the torsional moments of all forces at the point A about the center of the crankpin or eccentric rotation:

$$X \times OD = T \times OA = M\alpha$$

because the moment of the force Z which passes through the center of rotation is zero.

From Fig. 2, formula (1) can be expressed as

$$M\alpha = P\alpha \frac{S \sin(\alpha + \beta)}{2 \cos \beta} \quad (2)$$

This formula can be expressed as a function of the angle α alone by the formula

$$M\alpha = P\alpha \frac{S}{2} \left(\sin \alpha + \frac{K}{2} \frac{\sin 2\alpha}{\sqrt{1 - (K \sin \alpha)^2}} \right) \quad (2A)$$

In accordance with the Newton's binomial theorem $\sqrt{1 - (K \sin \alpha)^2} = 1 - \frac{1}{2} K^2 \sin^2 \alpha - \frac{1}{8} K^4 \sin^4 \alpha$.

The values of K^2 , K^4 and so forth and of \sin^2 , \sin^4 etc., are very small. Therefore, to all practical results the value of $\sqrt{1 - (K \sin \alpha)^2}$ can be accepted to be equal to unit and consequently

$$M\alpha = P\alpha \frac{S}{2} \sin \alpha + \frac{K}{2} \sin 2\alpha \quad (3)$$

This is the basic formula for ascertaining the slide pressure at any position of the slide in the press disregarding frictional and constructional losses. At the midstroke of the slide the angular position of the crankpin or of the eccentric is about 90 deg from their lower dead point. Let us assume that it is equal to 90 deg. Then

$$\sin \alpha = \sin 90^\circ = 1$$

$$\sin 2\alpha = \sin 180^\circ = 0$$

and the formula can be presented as

$$M_m = P \frac{S}{2} (\sin \alpha - \frac{K}{2} \sin 2\alpha) = P \frac{S}{2} \quad (4)$$

where

M_m = torsional moment on the crankpin or eccentric, in.-tons.

P = "rated" pressure capacity of the press, tons.

S = stroke of the slide, in.

Presses of crankshaft type are built on the basis of the torsional strength M_t of the crankshafts used. The torsional moment which any round shaft, including crankshafts, can withstand, according to the theory of the strength of materials, is

$$M_t = \frac{\pi d^3}{16} S_{sh} \approx 0.2 d^3 S_{sh} \quad (5)$$

where

d = diameter of the shaft, in.

S_{sh} = shearing resistance of the shaft material, tons per sq in.

The midstroke capacity of the press can now be expressed as

$$M_t = 0.2 d^3 S_{sh} = P \frac{S}{2}$$

hence

$$P = \frac{2}{S} \times 0.2 d^3 S_{sh} = \frac{0.4 d^3}{S} S_{sh}$$

Press crankshafts are mostly made of 0.35 - 0.45 percent carbon steel, forged and heat treated. The shearing strength of the steel in such crankshafts is usually taken to be 6 tons per sq in. for all

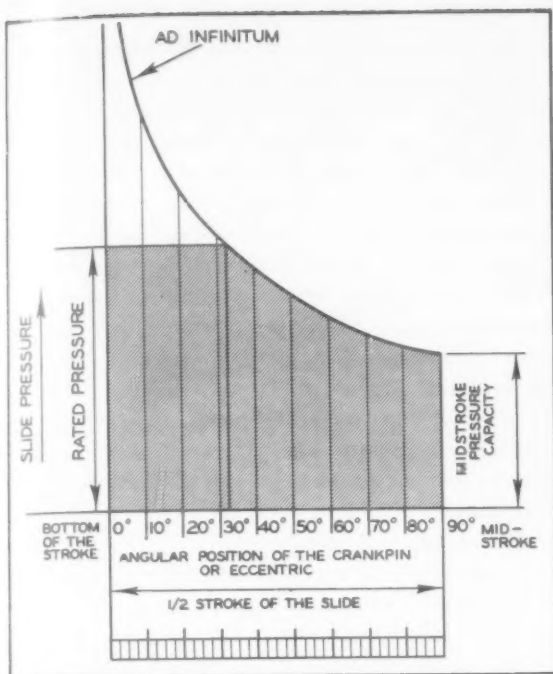


Fig. 3. Above is shown the pressure which the slide exerts at each angular position of the crankpin or eccentric of the press.

single driven presses with a flywheel or a bull gear on one end of the crankshaft, and 9 tons per sq in. in twin driven presses with bull gears on each end of the crankshaft. The latter drive is used on presses with crankshafts of over 7-in. diameter, with the slide stroke longer than twice the crankshaft diameter at main bearings and in all wide, right-to-left presses.

The simplified formulas for midstroke capacities P_m in the crankshaft type presses are, then

Single driven presses:

$$P_m = \frac{0.4 d^3}{S} S_{sh} = \frac{2.4 d^3}{S}$$

Twin driven presses:

$$P_m = \frac{0.4 d^3}{S} S_{sh} = \frac{3.6 d^3}{S}$$

The basic formula (3) enables a chart, Fig. 3 to be drawn for each press giving the pressure which the slide is expected to exert at each angular position of the crankpin or eccentric in the press.

This chart can be converted to a practical use by adding another scale based on the distance h of the slide from its lower dead point at each angular position of the crankpin or eccentric.

Why Presses Stall and Break

Referring to Fig. 2, the distance of the slide from its lower dead point with the crankpin or eccentric at an angle α is, depending on the pitman ratio, about:

$$LB = L_1 C = \frac{S}{2} (1 - \cos \alpha)$$

Thus, at each angular position of the crankpin or eccentric in the press the slide will be at a certain position from the bed of the press as it is shown in Fig. 3. For each press a separate chart must be made as its curve depends on the stroke of the slide and the "pitman ratio."

The basic formula (3) explains also the causes of the breakdowns and stalling of presses because of an incorrect adjustment of the press connection or on account of an accidental obstruction finding its way into a die. When the slide is at the bottom position of its stroke:

$$\begin{aligned} \alpha &= 0^\circ \\ \sin \alpha &= \sin 0^\circ = 0 \\ \sin 2\alpha &= \sin 0^\circ = 0 \end{aligned}$$

From basic formula (3):

$$Pa = \frac{Ma}{\frac{S}{2} (\sin \alpha + \frac{K}{2} \sin 2\alpha)} = \frac{M}{0} = \text{infinity}$$

Since all constructional details in the press construction are built to withstand a certain load, the press in such a case must stall or something must break.

Single-Action Presses

The "single-action" presses are used with the material or article absolutely free while the punch performs its work. This condition permits the use in these presses of any automatic feeding device, and thus speeding up their output. These presses find commonest application in the following duties:

Shearing operations: blanking, cut-off, notching, parting, piercing, shaving, shearing, trimming, etc.

Riveting operations

Squeezing operations: beading, coining, embossing, stamping, sizing, etc.

Reducing operations: ironing, reducing

Drawing operations: drawing, redrawing

Shearing, riveting and squeezing operations are done near the bottom of the slide stroke. If the pressure required for performing this work is known, the press is selected in accordance with its rated capacity.

Reducing and drawing operations start near the midstroke of the slide. The selection of a suitable press must, therefore, be based on its midstroke capacity. Single-action presses used for drawing and redrawing work must be equipped with pneumatic die cushions, or with rubber or spring buffers in their tables or beds. The compression resistance of the cushion or buffer must be added to the pressure calculated for performing the reducing or drawing work. It may be taken to be equal to about 30 percent of the work pressure requirement.

Double-Action Presses

The double-action (or slide) presses were developed for drawing and redrawing work where a flat blank is transformed into a cup (shell) form, or where a previously drawn cup is reduced in its diameter and consequently increased in its depth.

Double-action presses have two slides, one sliding inside another. The movement of these slides is arranged in such a manner that the outer slide dwells (stands still) in the lowest position while the inner slide, which lags behind, passes through its lowest dead point, after which both slides return to their starting position in the press. The outer slide equipped with a suitable punch, serves to hold the material or the article to the face of the die while the punch mounted on the inner slide performs the necessary, usually the drawing, operation. In these presses the "action" is thus confined to the inner slide only.

The inner slide in these presses is actuated either by crankpin(s) or gear eccentric(s), while the outer slide by cams or a toggle link mechanism. The presses are, therefore, called cam drawing or toggle drawing presses.

In cam drawing presses the cams are mounted on the cheeks of the crankpin which limits the size of the work and the depth of the draw for which these presses can be used. The toggle drawing presses are built of single, two or four-suspension types for work of any required size within the depth of draw specified by the press builder, the depth being controlled by the design of the toggle link mechanism of the press.

The outer slide in drawing presses holds the material or cup to the face of the die, at the same time preventing the formation of wrinkles and folds in the walls of cups or shells during the drawing operation. It is often called the blankholding slide.

Double-action (slide) presses are not as adaptable for use of automatic devices as are the single action presses.

Triple-Action Presses

"Triple-action" presses are in reality "double-action" presses with an inverted single-action press, either inside the bed of the press or attached to it. The movement of the lower slide is made and timed either by a link mechanism connected to the main drive of the upper press or by an independent motor drive arrangement in which its clutch is electrically or cam controlled from and timed by the drive of the upper press. The proper name for these presses should be accordingly "triple-slide" presses and not "triple-action" presses because only the upper inner slide and the lower slide are the actually "acting" or working slides. The "triple-action" presses have a limited use, mostly in the automobile body work.

Mechanical Versus Hydraulic Presses

The mechanical power presses are meeting with a strong competition from the self-contained hydraulic presses. This came with the invention of the variable-delivery, rotary, radial piston pumps which permitted building these presses as a self-contained machine tool unit with the pump, its motor, oil reserve tank and electrically controlled valves all mounted on the top of a streamlined press frame.

The hydraulic presses can be built of any stroke, pressure capacity, and with variable speed of the slide movement, depending only on the diameter of the cylinder, strength of frame (tie rods) and on the pressure capacity of the pump.

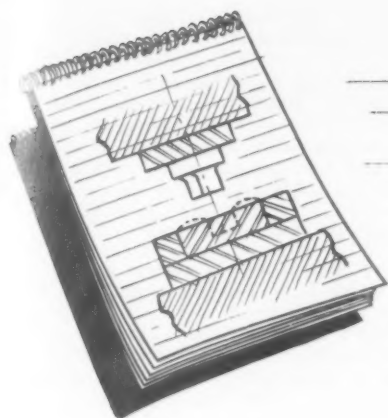
Hydraulic presses, however, are less economical than mechanical presses that can efficiently perform a specific identical duty. The pumps consume a great amount of electric power which is lost with each new stroke of the slide and the oil pressure in the cylinder has to be built up from zero in a comparatively short period of time. This requires the use of pumps served by motors of several times the capacity used in mechanical presses of corresponding tonnage pressures. Furthermore, the sudden release of the pressure in hydraulic presses is accompanied with a sudden contraction of the cylinder and its hydraulic conduits, placing great stress on pipe joints, valves and their springs, making the upkeep cost of hydraulic presses higher than that for mechanical presses. The servicing of hydraulic presses requires skilled and better paid mechanics which further increase the overhead production costs.

On the credit side of the hydraulic presses, both the pressure and the speed of the slide movement are under full control of the press operator. The presses can be built with any length of slide stroke, which is of decisive advantage in extreme deep drawing or ironing work. Furthermore the slide may be held under a pressure indefinitely, which is advantageous when thermosetting action is involved.

The hydraulic presses are most suitable for single action with a single working cylinder. Capacities are controlled by the area of the press plunger and the pressure capacity of the pump.

In the case of double-action (or slide) hydraulic presses, and when two or more cylinders are used, much trouble may occur because the oil in the press conduits flows wherever there is the least pressure resistance. To alleviate this condition a complicated hydraulic conduit system has to be installed with numerous relief, by-pass, cut-off and other valves.

Hydraulic presses are preferred for deep drawing or ironing work, for coining and embossing, for processes involving any thermosetting process with such materials as plastics, wood, fiber and leather for work with rubber forming pads (substitute-female die) and in powder metallurgy work.



A notebook on die design....

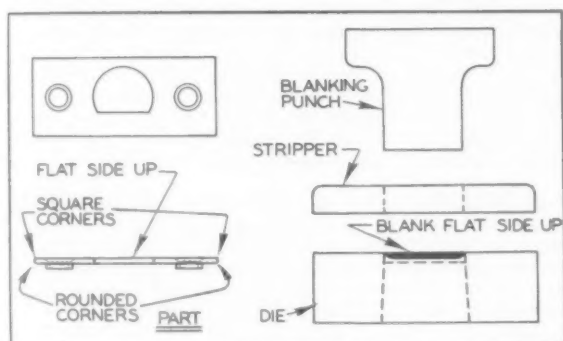
By John S. Brozek
SARGENT AND COMPANY

PART II

2. Type of Die for Proper Manufacturing

A. Compound die for precision stampings where close tolerances are required to maintain size, concentricity and flatness.

B. Progressive die for all normal tolerances and application for volume production. Elimination of secondary operations for cost reduction, where secondary handling will add to hazard of accumulative error in making a complicated part due to setup and human error.

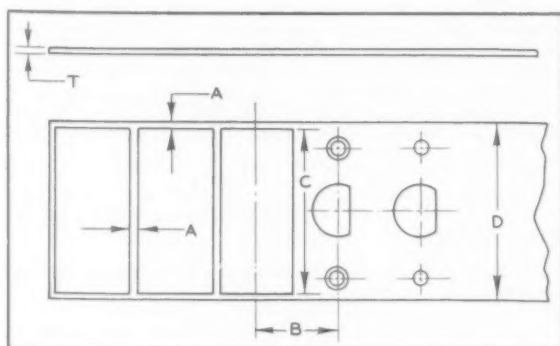


3. Correct Layout for Burr Side

For functional reasons, the particular stamping may require to have the right side burr which the part drawing does not specify. This, however should be checked before proceeding with the die layout in order to get the burr on the proper side of the blank.

4. Making Allowance for the Flat Side of a Blank

Blanking dies produce a blank having what is termed a flat side or round side. The flat side is a side in which the edges are left square with the surface of the strip, and the round side has slightly rounded edges. In many cases it is absolutely necessary that one certain side of the blank be kept as a flat side, especially when this side is to be assembled to some other unit. Therefore, in making a layout for a blanking or progressive die, the flat side must be shown against the punch.



5. Scrap Allowances for Blanking Dies

For successful die performance and economy standpoint, it is important to have the proper scrap strip allowance applied to material layout. Too great an allowance is wasteful of material on long runs. A scrap layout having insufficient stock between the blank and the strip edge will result in a weak scrap strip, subject to breakage, causing misfeeds resulting in unnecessary die maintenance due to partial cuts which deflect the punches, causing nicked cutting edges. When insufficient scrap is allowed, upon blanking, the punch pulls the material around itself resulting in severe dished blanks.

The following is a safe established scrap allowance to be followed as per outlined sketch.

T = Thickness of material

$A = 1\frac{1}{4} \times T$ where "C" is less than $2\frac{1}{2}$ in.

$A = 1\frac{1}{2} \times T$ where "C" is more than $2\frac{1}{2}$ in.

Scrap Layout Formula

Center to center distance "B" standard dimensions

Strip width "D" standard commercial dimensions that can be procured

(Note:—In general practice of allowing scrap between blanks of $1/32$ inch thickness and up, a general rule of $1\frac{1}{2} \times T$ is in order for good results in die operation.

Formula for Computing Weight Per 100 Blanks

B = Lead of die in inches

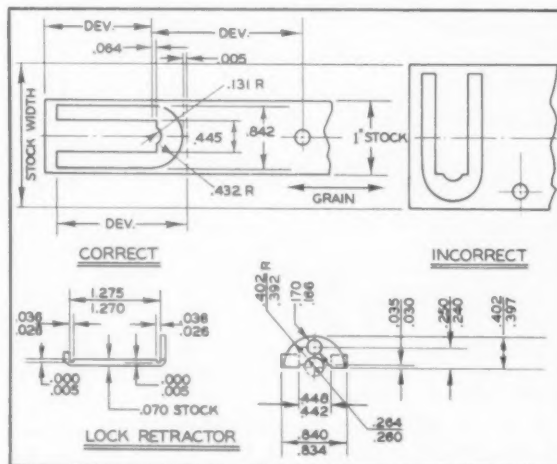
E = Number of feet required per 100 blanks

F = Weight in lb per lineal feet of specific material

G = Weight of material in lb includes scrap to make 100 blanks

$$E = \frac{B \text{ in.} \times 100}{12 \text{ in.}}$$

$$G = E \times F$$



If the blank is to be subsequently formed or bent, especially with sharp cornered bends on heavy gage materials, care must be used in positioning the blanks relative to grain in the strip. For the best forming or bending condition it is advisable to bend or form at right angles to the grain, but blanks can safely be made at one angle of 20 deg to the grain. The grain direction is usually parallel with the strip edges. If this precaution is overlooked, the bends are likely to fracture, especially if they have sharp right angled corners.

Minimum Scrap Allowances

For thin gage material above outlined, formula for laying out scrap strip would not apply. That is for gages of material of 0.025 in. thickness or less. The following would be applicable:

Strip Width (in.)—D	Space—A
0 to 3	0.050
3 to 6	0.093
6 to 12	0.125
Over 12	0.156

When designing progressive dies which have formed or drawn section, extra allowances must be made for material drawn or bent. In pinch trimming, operations on thin materials a minimum of $\frac{1}{8}$ to $\frac{1}{4}$ material in scrap must be allowed for proper die feedings.

Typical Examples

Formulas and layout for pinched trimmed parts for scrap layout.

A = Lead of die in inches

B = Calculated blank diameter with allowance for dimension "C"

C = Scrap width around blank after pinch trimming:

0.125 on material width up to 4 in.
0.250 on material width over 4 in.

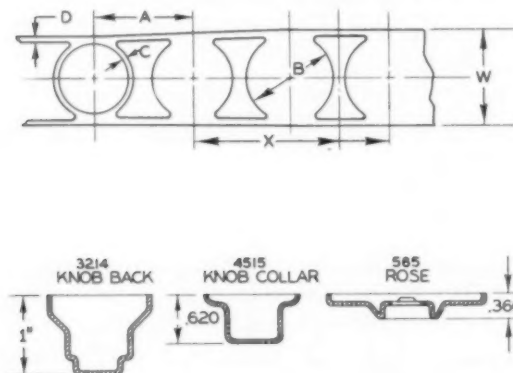
D = 0.125 or 0.250 determined by slitting punch

X = Position of slitting punch to first move

W = B + 0.187 shallow draws 0.250 depth

W = B + 0.312 for draws over 0.250 to 0.625 depth

W = B + 0.375 for draws over 0.625 to 1.000 depth



6. Production Requirements Determine The Classification And Construction Of Dies

Class AA Die—For large volume production where extreme accuracy of parts must be maintained. A die of this type must be built with the highest grade of workmanship and material to give maximum service with very low maintenance cost. The following should be adhered to:

A. Specify precision all-steel die sets with four pillar pins and extra long guide bushings for keeping die alignment with greater accuracy.

B. The die block should be made to thickness best suited to the work but not less than $\frac{7}{8}$ in. thick; cutting parts of the die are to be within limits of plus or minus 0.0008 in., based

on a master template system where die template is made to minimum product drawing dimensions; the die should have a minimum straight wall length of $\frac{1}{4}$ to $\frac{1}{2}$ inch followed by a 0.5 deg taper. In some cases a 0.25 deg taper for the entire length of die thickness may be required; the die should have bushings for all piercing holes wherever possible. All bushing holes in die or die sections should be jig ground to eliminate any error that may have been brought about during the hardening process. A section should be provided for each station, wherever possible, should be form ground; all weak sections should be inserted for ease in die maintenance.

C. Stripper is to be made of machine steel or a good grade of tool steel fitted closely to the blanking punch; all piercing punches should be guided by hardened bushings in the stripper, wherever possible. When a spring stripper is used it should be guided by lead pins mounted in the punch holder, with hardened guide bushings in the stripper plate for good alignment of piercing punches.

Class A Die

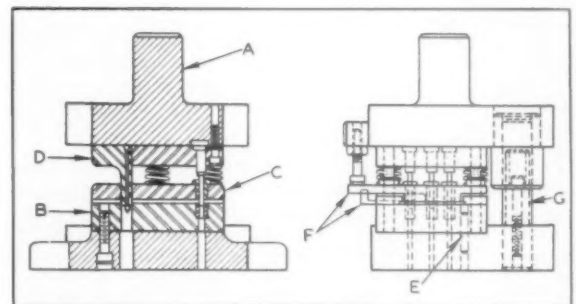
Construction of dies of this type are to be made of high-grade workmanship and material for average requirements and volume production, giving long service with low maintenance cost.

The following should be adhered to:

A. Specify precision all steel dies sets to suit individual requirements.

B. Die block should be made to thickness best suited work, but not less than $\frac{7}{8}$ in. thick; cutting parts of the die are to be held within limits of plus or minus 0.0015 in., based on master template system where die template is made to minimum product drawing dimensions; the die should have a minimum straight wall length of $\frac{1}{8}$ in. on all material less than $\frac{1}{2}$ in. thickness; on heavier material, straight wall length should be equivalent to material thickness, followed by a taper of $\frac{1}{2}$ deg; a section should be provided for each station wherever possible; all weak sections should be inserted for ease in die maintenance; all piercing holes should be bushed.

C. Stripper is to be made of machine or good grade of tool steel fitted closely to the blanking punch; all piercing punches are to be guided by hardened bushings in the stripper wherever possible; when a spring stripper is used, it should be guided by lead pins mounted in the punch holder, with hardened guide bushings in the stripper plate for good alignment of piercing punches.



D. Blanking punch should have its own solid base for mounting; the punch plate for piercing punches should be of adequate thickness to provide good stability in operation, it should be made of a good grade of tool steel; piercing punches should have hardened backing plates to take the thrust of the piercing punches; blanking and piercing punches to have shedder pins wherever it is possible to install them.

E. Dowel pin holes are to be lapped.

F. Feed stops should be provided for each move as required, including an automatic stop.

G. Bumper block must be provided when forming, lancing, extruding, or embossing is performed.

H. Clearance and alignment of punches and dies should be such as to produce blanks free from burrs.

Statistical Aids for **Tool Engineering**

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Part III—Measuring the Distributions of Errors

THE VARIATIONS OF a dimension produced in an operation are the result of a number of causes of error, all acting at the same time. The basic causes of error are:

1. Wear. This takes place on locating surfaces, between moving parts of machines and tools, and at cutting edges. Wear is a factor that inevitably adds to the variation over a period of time.
2. Deflection. Forces act in all cutting and forming processes, and deflection is ever present. Constant deflection can be anticipated but variations in deflection are hard to eliminate.
3. Thermal expansion, which may be both generally uniform and locally variable.
4. External disturbances, such as dirt, chips, and burrs.
5. Errors of human judgment and lack of skill.
6. Intrinsic defects in tools and machines. Errors in the original sizes of tool details may be kept small, but cannot be avoided altogether without prohibitive cost.
7. Variations in raw material.
8. Variations in dimensions of rough workpieces, coming from previous operations.

Work locating and holding devices, cutting and forming tools, machines, gages, and men all contribute to metal working operations in particular, and to all kinds of manufacturing operations in general. The effect that each has upon any one workpiece is influenced by one or more of the basic causes of errors.

Classes of Errors

For convenience, causes of errors are often di-

vided into two classes. One class contains those called assignable causes, which are considered correctible. The others are known as non-assignable causes, sometimes thought of as chance causes. In effect, non-assignable causes are those that are so small that it doesn't pay to investigate them separately. They include variations in rough workpieces within specifications, minute deflections, and that amount of looseness between machine members required for free movement. In contrast, examples of assignable causes of error are rough workpieces outside of specifications, incorrect tool settings, and badly worn equipment.

Causes of errors also may be looked upon in another way. A cause may be random in its effect; a cause may exhibit a definite trend; or a cause may have a specific pre-disposition. Those features are found even in assignable causes.

Tool wear is a common cause of error exhibiting a definite trend. Its effect is to cause a more or less gradual but certain displacement in the average of an otherwise stable universe and thus bring about an increase in the dispersion.

A cause having a specific predisposition is the position of a drill bushing in a jig. Once the bushing plate is bored within specified limits, it casts a definite bias upon the performance of the jig. In general, predisposed errors impart a bias to average results. Often they tend to compensate for each other.

The desirable state of any operation is that which prevails when all assignable causes have been eliminated. Variations then result from a seething mass of smaller variables. None of them is dominant and all are associated with one another in bewildering

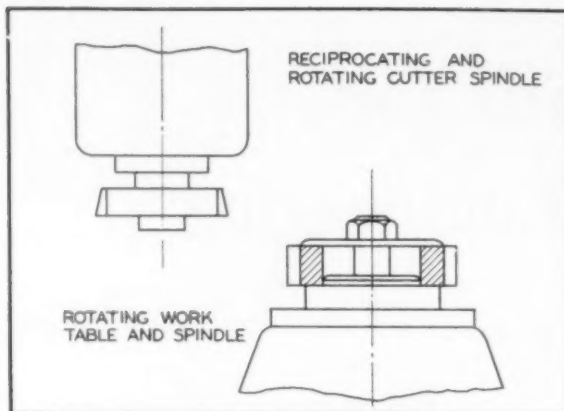


Fig. 1. The elements of a gear shaping operation, shown in diagrammatic form.

combinations. Those that occur at random tend to set up an approximately normal pattern. Those predisposed may affect the average somewhat, and those with a definite trend act to enlarge the dispersion.

Influence of Errors on Operation

Example 1. An idea of the influence of the causes of error upon the performance of an operation may be had by examining a typical case. The essentials of a gear shaping operation are sketched in Fig. 1. The blank is held over a plug of a fixture mounted on the work table of the machine. The cutter is mounted on a reciprocating spindle. A list of the individual errors inherent in the operation is:

Cutter with commercial tolerance	
for the diameter of the hole of	0.0005 in.
for the runout of the teeth	0.0005 in. T.I.R.
Diameter of cutter spindle below size	0.0010 in.
Runout of cutter spindle	0.0005 in. T.I.R.
The tolerance of the hole of the workpiece	0.0010 in.
The maximum clearance of the work locating plug (below size)	0.0006 in.
(A reverse taper on the other end of the locating plug may be assumed to fit the work spindle snugly.)	
Runout of work spindle	0.0005 in. T.I.R.
Maximum possible runout of gear	0.0046 in. T.I.R.

The eccentricity indicated by the sum is that which would result if all errors happened to occur at their maximum values at the same time, a highly improbable circumstance.

The cutter errors are maximum values, and any one cutter can be expected to be somewhere within the tolerances. When a cutter is installed on the machine, there is a certain looseness between it and

1	2	3	4	5	6
X DEVIATION FROM MEAN DIMENSION	INCH ACTUAL DIMENSION	FREQUENCY TALLY	f FREQUENCY	f.X	f.X ²
15	0.6265	/	1	15	225
10	0.6260	///	4	40	400
5	0.6255	/// //	15	75	375
0	0.6250	/// // // //	17	0	0
5	0.6245	/// /	6	30	150
10	0.6240	///	5	50	500
15	0.6235	//	2	30	450
0.0001 UNITS		TOTAL	50	20	2100

Fig. 2. Chart of distribution of a sample. Computations:

Sample size: $n = 50$
Average dimension: $20/50 (0.0001) + 0.6250 = 0.62504$ in.
Standard deviation: $\Delta x = \sqrt{\frac{2100 - 400}{50}} / 50 = \sqrt{41.84}$
 $0.0001 \sqrt{41.84} = 0.000647$ in.
6Δ spread = 0.00388

the spindle. It will assume a slightly off-center position in which it is held when the spindle nut is tightened. That gives a definite predisposition to performance. But as successive cutters are placed on the spindle over a long period of production, they will occupy random positions and contribute random errors in the long run. The same may be said of the workpieces on the locating plug and work spindle. Those errors in location and the errors in runout in the machine members tend to neutralize each other.

Charts of Results

One way of getting an idea of the distribution of variations coming from an operation is to measure a number of pieces and tabulate the results. That method is illustrated by Fig. 2. Column 3 gives a picture of the distribution of 50 pieces taken at random from the output of an operation. The computations lead to figures for the average and standard deviation.

A necessary assumption of the method depicted by Fig. 2 is that the sample is like the universe from which it has been taken. The larger the sample, the more assurance there is that it is representative.

Introduction to Statistical Quality Control

The procedure of statistical quality control is to take samples from an operation and plot points from the observations on a control chart. A sample is made up of small sub-groups, the choice of which is a matter of expediency and judgment. Frequent small sub-groups are preferred to infrequent large groups, although fewer than four pieces are not considered desirable.

The article in any sub-group should be produced under the same essential conditions. They should have some important common factors like being produced during one short interval of time or coming from one of several distinct sources. The different sub-groups should represent possible distinct facets of an operation, such as different intervals of time or different sources. These precautions help to insure significant samples.

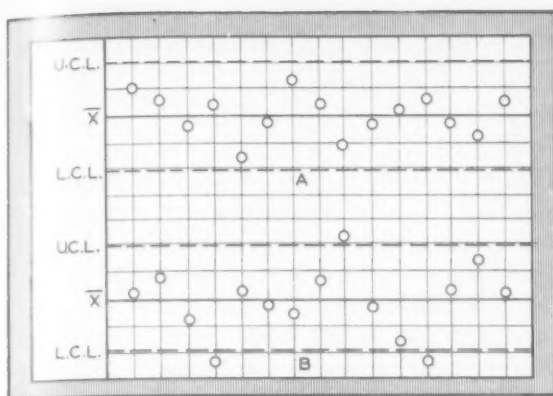


Fig. 3. Form of a typical control chart.

Basic Concepts

In statistical quality control work, the averages of the sub-groups are computed and plotted in sequence on a control chart, like in Fig. 3. Calculations also may be made of the spreads of the sub-groups. The positions and behavior of the plotted points are interpreted to estimate the average and dispersion of the universe of variations from which the sub-groups are taken. The control chart also can be made to tell how reliable it reflects the universe. In practice, only a comparatively few observations can be made.

It is essential to establish first of all that all the observations made in any one case are from one universe. That condition is found to exist when all the errors in an operation result from a constant system of chance or random causes.

The Significance of the Sub-Group Averages

The arithmetic averages of the sub-groups are plotted on the control chart in the order in which the sub-groups are taken, as in Fig. 3. The averages of the individual sub-groups are the \bar{X} points. These averages likewise have an average, called $\bar{\bar{X}}$, shown by the heavy line. A bar over a symbol is a convention to indicate an average. The double bar signifies an average of an average.

Two important principles relate the sample to the universe. They are

1. The average of a sample approximates the average of the universe and approaches closer with increasing sample size. That means that $\bar{\bar{X}}$ is an indicator of the average of the universe.

2. The standard deviation of the distribution of sub-group averages approaches the standard deviation of the universe divided by the square root of the sub-group size. This may be expressed by

$$\Delta\bar{X} = \frac{\Delta'}{\sqrt{n}} \quad (1)$$

where n = number of pieces in each sub-group.

$\Delta\bar{X}$ = standard deviation of the distribution

of the average points around the mean.

Δ' = standard deviation of the universe from which the sample is taken. The prime sign after a symbol means that it stands for a property of a universe.

It should be noted that not only can individual measurements be arranged in distribution, but that the properties of those same distributions can likewise be so arrayed. Thus, each sub-group taken from a universe is in itself a small distribution. It has an average and a standard deviation. But even more, the averages of the sub-groups can be thought of as making up a distribution of their own. That secondary distribution also has an average, which is $\bar{\bar{X}}$, and a standard deviation, which is $\Delta\bar{X}$.

A principle that is useful is that the distribution of the sub-group averages approaches that of a normal curve as the sample becomes larger. That is the case no matter what the distribution of the universe from which the sample is taken. Also, if the universe is normal, the distribution of averages is normal for any size sub-groups. Because of their normal distribution, practically all the sub-group averages should be inside limits set at $\bar{\bar{X}} \pm 3\Delta\bar{X}$. That gives a basis for fixing limits inside which all the \bar{X} points can be expected to fall if the process is in control. Such limits are represented by the dotted lines of Fig. 3. They are called control limits and are established by the performance of the operation alone. One is abbreviated U.C.L. for upper control limit, and the other L.C.L. for lower control limit.

If all points fall within with the control limits on an \bar{X} chart and are fairly well distributed above and below the $\bar{\bar{X}}$ line, as in Fig. 3A, there is reasonable cause to believe that control exists. On the other hand, if point falls outside of the limits, as in Fig. 3B, trouble is indicated.

The control limits are sometimes called action limits. They are chosen to indicate when to look for assignable causes of error. Their purpose is to point to a situation which will not cause a search for trouble that does not exist but will bring action for trouble that does exist. Thus, the situation of Fig. 3A indicates that all variation is due to causes that are unprofitable to investigate. Fig. 3B gives evidence, of strong causes of error that may be found and eliminated to make a more uniform product.

Standard Deviation of Variation

An estimate of the standard deviation, $\Delta\bar{X}$, of the average points may be computed directly from an array of the points themselves. But a more reliable estimate can be obtained in another way.

Investigations have shown that the average of the standard deviations of a set of sub-groups, designated by $\bar{\Delta}$, is related to the standard deviation, Δ' , of the universe. That relation is written as

$$\bar{\Delta} = C_2 \Delta' \quad (2)$$

The factor C_2 has been shown by statisticians to have the value,

$$C_2 = \sqrt{2/n} \frac{\left(\frac{n-2}{2}\right)!}{\left(\frac{n-3}{2}\right)!} \quad (3)$$

The letter n stands for the number of items in each sub-group. From equation (1) and (2) it is seen that

$$\Delta \bar{X} = \frac{\bar{\Delta}}{C_2 \sqrt{n}}$$

In practice, the control limits for an \bar{X} chart are set at $\bar{X} \pm A_1 \bar{\Delta}$. That is equivalent to $\bar{X} \pm 3 \Delta \bar{x}$.

$$\text{Thus, } A_1 = 3 \Delta \frac{\bar{X}}{\bar{\Delta}} = \frac{3}{C_2 \sqrt{n}}$$

Tables giving values of C_2 and A_1 for common sub-group sizes are found in texts and reference books on statistical quality control. To find the control limits for an \bar{X} chart, calculate the stand-

ard deviations of the individual sub-groups, average them to get $\bar{\Delta}$, multiply that value by A_1 , and add and subtract the product from \bar{X} .

Range

Because calculations of standard deviation are somewhat tedious, a simpler property of a distribution is more often used in control chart work. That is the range designated by the capital letter R . The range of any group is the arithmetic difference between the highest and lowest values in the group. Thus a group containing the numbers 2, 3, 7, 8 and 9 has a range of $9 - 2 = 7$. The range is a measure of dispersion like the standard deviation, although not so sensitive.

When the range is used, the average of the ranges of the sub-groups, denoted by \bar{R} , is computed. This average range is related to the standard deviation, Δ' , of the universe, as is $\bar{\Delta}$. The relationship is somewhat complex but has been reduced to tabulated values for various sub-groups sizes. Such tables can be used to calculate the limits for \bar{X} and R charts from \bar{R} .

When a range chart is used instead of a Δ chart, the values of ranges of successive sub-groups are

FIG. 4. CONTROL CHART DATA SHEET

Product: Bushing.							Production Order: 916-8-7							Date: 10-19-48		
Characteristic: 1.000 O.D.							Prod. Dept. No.: 9							Insp. No.: 0083		
Unit of Measurement: .0001 in.							Normal Daily Output: 3000									
Specified Limits: .0005 min.							Sample: 5 per 1/4 hr.									
Specs. No.:							Method of Measurement: Dial Comparator.									
							Inspector: R.L.H.									
Measurements of Items in Average																
Sub-Group No.	Time	Sample	Show	From	Mean		\bar{X}	\bar{X}^2	$\Sigma \bar{X}^2$	$\frac{\Sigma \bar{X}^2}{n}$	$\Delta 2$	Δ	Hi	Lo	R	
1	7:30	-1	0	0	-1	+1	-0.2	.04	3	.6	.56	.75	+1	-1	2	
2	7:42	0	-2	0	0	+3	+0.2	.04	13	2.6	2.56	1.6	+3	-2	5	
3	7:59	0	+1	-2	0	0	-0.4	.16	6	1.2	1.04	1.02	+1	-2	3	
4	8:13	+1	+1	0	0	0	+0.4	.16	2	.4	.24	.49	+1	0	1	
5	8:30	0	0	+1	-3	-2	-0.8	.64	14	2.8	2.16	1.47	+1	-3	4	
6	8:44	0	-1	-4	-2	+2	-1	1	25	5	4	2	+2	-4	6	
7	8:57	+3	0	0	+3	-1	+1	1	19	3.8	2.8	1.67	+3	-1	4	
8	9:10	0	+1	+1	+1	-1	+1	1	7	1.4	.4	.63	+2	0	2	
9	9:22	0	+1	+1	-1	+2	0	0	4	.8	.8	.89	+1	-1	2	
10	9:45	-5	-1	-2	+2	0	-1.2	1.44	34	6.8	5.36	2.32	+2	-5	7	
11	10:00	-1	-1	0	-1	-2	-1	1	7	1.4	.4	.63	0	-2	2	
12	10:14	-2	-1	-1	-2	+1	-1	1	11	2.2	1.2	1.1	+1	-2	3	
13	10:31	-1	+2	-2	0	+1	0	0	10	2	2	1.41	+2	-2	4	
14	10:45	-2	+1	0	0	0	-0.2	.04	5	1	.96	.98	+1	-2	3	
15	11:02	+1	+1	-1	-3	0	-0.4	.16	12	2.4	2.24	1.49	+1	-3	4	
16	11:15	-3	-3	+2	+2	-1	-0.6	.36	27	5.4	5.04	2.24	+2	-3	5	
17	11:29	+2	-2	-2	+1	0	-0.2	.04	13	2.6	2.56	1.60	+2	-2	4	
18	11:43	-1	+1	0	+3	0	+0.6	.36	11	2.2	1.84	1.36	+3	-1	4	
19	11:55	-1	-1	-1	0	-5	-1.6	2.56	28	5.6	3.04	1.74	0	-5	5	
20	1:00	-1	+1	0	-1	-3	-0.8	.64	12	2.4	1.76	1.33	+1	-3	4	
21	1:14	0	0	-2	+1	+2	+0.2	.04	9	1.8	1.76	1.33	+2	-2	4	
22	1:27	-3	0	0	+1	-1	-0.6	.36	11	2.2	1.84	1.36	+1	-3	4	
23	1:45	+2	+3	-1	0	-1	+0.6	.36	15	3	2.64	1.62	+3	-1	4	
24	2:01	-3	0	+2	0	0	-0.2	.04	13	2.6	2.56	1.60	+2	-3	5	
25	2:15	+2	-2	-3	+2	0	-0.2	.04	21	4.2	4.16	2.04	+2	-3	5	
							$\Sigma \bar{X} =$	-6.4			$\Sigma \Delta =$	34.67	$\Sigma R =$		96	
							$\bar{X} =$	-.26			$\Delta =$	1.39	$R =$		3.84	
Results from hourly check on second day (10-20-48)																
26	8:00	+1	+3	+5	+3	+4	+3.2	10.24	60	12	1.76	1.33	5	1	4	
27	9:00	+2	+4	+5	0	0	+2.2	4.84	45	9	4.16	2.04	5	0	5	
28	10:00	-2	+2	+5	+2	+1	+2.4	5.76	38	7.6	1.84	1.36	5	1	4	
29	11:00	+4	+3	-1	0	+3	+1.8	3.24	35	7	3.76	1.94	4	-1	5	
30	2:00	+5	+7	+3	+5	0	+4.0	16.0	108	21.6	5.60	2.36	7	0	7	
31	3:00	+4	0	+1	+2	+3	+2.0	4.0	30	6	2.0	1.41	4	0	4	
32	4:00	+1	+5	+3			+2.8	7.84	48	9.6	1.76	1.32	5	1	4	
Results from hourly check on third day (10-21-48)																
33	8:00	+3	0	0	-3	0	0	0	18	3.6	3.6	1.89	3	-3	6	
34	9:00	+3	0	+7	-4	-2	+0.8	.64	78	15.6	14.96	3.86	7	-4	11	
35	10:00	-1	+3	-2	+5	+4	+1.8	3.24	55	11.0	7.76	2.78	5	-2	7	
36	11:00	+6	-6	-6	-1	+3	-0.8	.64	118	23.6	22.96	4.79	6	-6	12	
37	2:00	-8	+1	-4	-1	-6	-3.6	13.0	118	23.6	10.6	3.26	1	-8	9	
38	3:00	+2	+4	-4	+10	+8	+4.0	16.0	200	40.0	24.0	4.9	10	-4	14	
39	4:00	+3	0	-2	-1	-6	-1.2	1.44	50	10.0	8.56	2.93	3	-6	9	

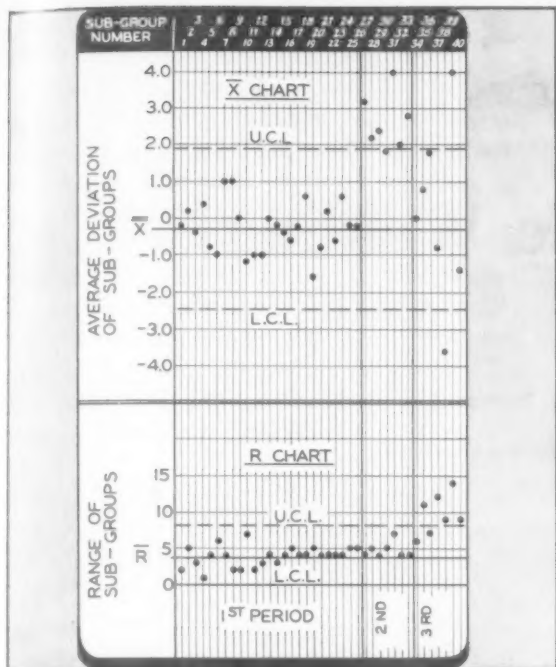


Fig. 5. Typical control chart, based on table of Fig. 4.

plotted, a line is drawn for \bar{R} , and the control limits are set at $\bar{R} \pm 3\Delta\bar{R}$. Actually, the control limits are computed by multiplying \bar{R} by a factor based on the sub-group size.

Example 2. A bushing has an outside diameter of 1.000 ± 0.0005 inch, finished on a centerless grinder. During a day's run, five pieces were taken for each sub-group at about 15 minutes intervals. The diameter of each piece was measured to find out how much it deviated from the mean in ten thousandth inch units. The deviations were entered on a chart, and the results for the first 25 sub-groups are shown in the upper part of the table of Fig. 4.

For each sub-group, values of \bar{X} and \bar{R} are shown in Fig. 4. For the initial sample of 25 sub-groups, \bar{X} and \bar{R} have been derived. The resulting points are plotted in Fig. 5. Lines are drawn on that chart to represent \bar{X} and \bar{R} also.

Standard tables show that the control limits for the \bar{X} chart should be

$$\bar{X} \pm A_2\bar{R} = \bar{X} \pm 0.577\bar{R} = (-0.26) \pm 0.577 \times 3.84.$$

Thus, the upper control limit is 1.96, and the lower control limit is -2.48. In a similar way, the control limits for the range chart are:

$$\text{Upper control limit} = D_4\bar{R} = 2.114 \times 3.84 = 8.11$$

$$\text{Lower control limit} = D_3\bar{R} = 0 \times 3.84 = 0.$$

For comparison, the values of Δ have also been computed, and are shown in Fig. 4. An estimate of Δ' of the universe is

$$\Delta' = \frac{\bar{\Delta}}{C_2} = \frac{1.39}{.8407} = 1.65$$

The value of C_2 for sub-groups of 5 pieces is 0.8407 and has been obtained from standard tables. The unit is 1/10,000 inch, and thus Δ' is 0.000165. Practically all the deviation are likely to be within a range of $6V'$, that is practically within 0.001 inch, the tolerance required. The sample is not large and the computed value of Δ' is only an estimate. More samples from a controlled process can be expected to give a more reliable estimate. But at any rate the available information shows nothing to indicate that the desired tolerance is not being observed.

For the initial period, during which the first 25 sub-groups were collected, all points plotted are within the desired bands and the evidence points to an operation in control. The situation for the remaining sub-groups 26 through 39 is different. These conditions indicate trouble. That will be discussed more fully in the next part of this series when the applications of control charts to specific tool engineering problems will be considered.

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Engineering Aspects of

Tool and Die Welding

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Part IV

DIE UNITS CAN be compositely fabricated by utilizing common SAE steels as a base and applying tool steel electrodes along cutting edges or over working areas. This results in a fabricated composite die unit constructed entirely of inexpensive steel.

The same construction principles can be followed on cast structures or carbon steel drawing and forming dies, by depositing alloy electrodes along sharp contours, belt lines and radii. This provides ideal drawing or forming surfaces to better withstand abrasion, scoring or fouling incidental to these operations, and prolongs the life of the units. In addition, flame-hardening dies can be fabricated using low alloy electrodes.

As deposits made with tool steel electrodes are hard as-welded, it is not necessary to subsequently heat-treat compositely fabricated units, other than tempering as recommended, if the units lend themselves to grinding. However, to facilitate machining, the deposits can be annealed and subsequently heat-treated with the recommended heat-treatment.

The medium-hard weld deposits of alloy electrodes used in tool and die welding require no heat-treatment. Hardness is increased solely by working.

Recommended Welding Sequence

1. Select the Proper Tool Steel Electrode.

Select the electrode with characteristics best suited for the type of work the units will have to do, taking into consideration any factors involving heat, abrasion, shock, thickness of metal to be cut or formed. The size of the electrode depends on the amount of deposition and the type of preparation selected.

2. Prepare the Surface to Be Welded.

There are four types of cutting or forming edges to be utilized in composite construction: angle, the 90 deg shelf, straight shelf and the self-created land types. With the exception of the latter, grind edges or surfaces enough to allow at least $\frac{3}{16}$ in. finished deposit of metal. Choose the type of preparation most economical and suitable to the design of the unit.

In preparing for composite fabrication, allow for two or more passes of the electrode. This will minimize the admixture of the electrode with the base metal and assure maximum uniform hardness as-welded.

On units that must be covered over large areas, prepare the base metal surface so that finished deposits will be at least $\frac{3}{16}$ in. deep.

In converting existing tool steel units into composite ones, rough grind edges to be welded to an approximate 45 deg angle to allow deposits of $\frac{3}{16}$ in. finished metal.

Allow for oversize to allow for finish machining or drilling after welding is completed. On ring-type or circular units, oversize dimensions should be at least $\frac{1}{8}$ in., which will allow for finish grinding or machining to the actual dimensions required.

On cast drawing and forming dies, using alloy electrodes, edges or areas to be faced should be prepared uniformly so that finished deposits are at least $\frac{1}{8}$ in. Over extremely large areas of cast iron units, staggering of studs is recommended and nickel, nickel-iron or copper-nickel electrodes used as intermediary electrodes. In these cases, provision

should be made in the preparation to allow for the additional deposits.

3. Preheat. In preheating, a controlled furnace is preferable. However, a hot-plate can be used to preheat small units and a gas fired brick furnace for large units. Preheating of large units can be done, if necessary, with the oxyacetylene torch.

A preheat of 200-400 deg F is recommended when using mild, medium carbon or high-carbon steel as a base. Smaller units will take the minimum of the preheat range and larger units the maximum.

When using SAE steels of the nickel-chromium varieties a preheat of 600-700 deg F is recommended.

4. Apply the Electrode. In composite fabrication the procedures to be utilized concur with those used in making repairs to existing tool steel die units.

5. Post Heat or Temper the Deposits. On compositely constructed units, tempering should always favor the deposited metal. The base metal acts only as a retaining medium for the cutting or working edge of the desired tool steel.

When existing tool steel units have been converted into composite units, the tempering should always favor the deposited metal and not the base metal or units themselves.

Units should soak at tempering temperature for a minimum of one hour.

All welded units should be tempered or drawn to suit requirements. Tempering gives toughness with very little depreciation of hardness, refines grain structures and relieves stresses and strains set up in welding operations.

It is not necessary to temper deposits of alloy electrodes, but a stress relief can be employed after welding.

ATOMIC-HYDROGEN ARC WELDING TOOLS AND DIES

Atomic-hydrogen arc welding differs from metallic arc welding in that the arc is formed between two electrodes rather than one electrode and the work. The welding heat is generated primarily by the recombination of atomic-hydrogen produced by dissociating hydrogen in its normal molecular state through the agency of an electric arc—hence the name atomic-hydrogen. The arc is completely surrounded by an atmosphere of hydrogen, which performs the double function of transferring heat from the arc to the work as well as shielding the molten metal from oxidization by the air. The arc provides a medium for heat transfer and aids in breaking down the hydrogen into its atomic form. The heat transfer also results in a re-combination of the atomic-hydrogen when the heat is liberated at the surface of the metal being welded.

TABLE I—SELECTION OF RODS FOR METALLIC-ARC WELDING REPAIR

Rods	For Welding or Repairing	Properties of Welds Produced
Water Hardening Tool Steel	Carbon, regular carbon and special carbon tool steels, with or without vanadium; water hardening alloy tool steels; water hardening chisel steels. Typical brands: Granada, Pompton, Latrobe, Black Diamond, Standard, Sterling, Extra, Special, Best, etc.	Typical carbon-vanadium water hardening tool steel. Superior toughness and resistance to fatigue. Have a wide hardening range.
Oil Hardening Tool Steel	Oil Hardening Steels of the Manganese, Tungsten or Chromium varieties of non-deforming or non-shrinking types. Typical brands: DeWard, Utica, Saratoga, Kiski, Stentor, Colonial 6, Vasco, Paragon, Ketos, Mansil, Mangano, Teemox, Truform, etc.	Typical oil hardening non-shrinking or non-deforming tool steel of the manganese type. Have excellent grain structure and cutting qualities, withstanding extreme shock. Closely retain size and shape after hardening and tempering, having small movement and non-warping tendencies.
Air Hardening Tool Steel (5% Cr. Type)	Typical air hardening tool steels of following types: 4 percent chromium; 5 percent chromium-moly.; 4 percent chromium-moly.; 1 percent or 2 percent chromium-manganese-moly. Typical brands: Air Hard, Airkool, Sports, Sagamore, MGR, M-10, etc.	Typical 5 percent chromium non-deforming air hardening tool steel. Can be hardened by quenching in oil or air. Have no tendency to crack in hardening. Wearing qualities are midway between the high-carbon high-chromium steels and the manganese oil hardening steels.
Air Hardening Tool Steel (High-Carbon High-Cr. Type)	Typical high-carbon high-chromium air hardening tool steels, either oil or air quench, having ranges of carbon from 1.5 percent to 2.25 percent and chromium from 11.00 percent to 12.00 percent. Typical brands: Ohio Die, Super Die, Airdie, Cromovan, Croloy, Ultra Die, etc.	Typical high-carbon high-chromium air hardening tool steel. Can be hardened by cooling in air or quenching in oil and have exceptional wearing ability with extreme resistance to abrasion.
Hot Work Tool Steel	Chromium, tungsten, high carbon-chromium, chromium-tungsten or molybdenum varieties of hot working tool steels. Typical brands: Atlas A&B, Hot Work, Marvel, Peerless A, B, C, D, LCT, Ajax W, Hot Form, Hot Die 2, LaBelle 89, Choice, Crescent, Hot Die, Potomac, etc.	Tough hot work tool steel that hardens from a relatively low temperature in air. Possess a combination of toughness and red hardness and in addition have outstanding resistance to heat checking as well as cracking from water cooling in service. Retains heat-treated hardness at temperature up to 1000 deg F.
High Speed Steel	By oxyacetylene method—high speed steel cutting tools; composite fabricating cutting tools; creating cutting, wearing or bearing surfaces. Typical brands: 18-4-1, 18-4-2 and cobalt high speed steels.	Cobalt-molybdenum-tungsten high speed steel. Excellent cutting characteristics coupled with abrasive resistant qualities comparable to, or exceeding, the typical high speed steels.
High Nickel-Chrome	Deformed, broken or spalled areas on hot or cold forging dies of the carbon types of chrome-nickel, chrome-moly., chrome-nickel-moly. and chrome-moly.-manganese varieties. Repairing hammer rams. Typical brands: Hardtem and Finkl Forge Die Blocks, various tempers. Excellent for creating bearing surfaces and repairing fractured tools and dies. Apply by atomic-hydrogen only.	Medium hard alloy deposits which are machinable after welding. Exceptional tensile strength. Work hardens in use. Resists abrasion and frictional heat. Takes high polish and is austenitic, resisting metal pick up, erosion and corrosion. Not affected by heat-treatment.
SAE Steels		
S.A.E. 4130	Chromium-molybdenum steel forgings, castings, structures, etc.	Chromium-molybdenum specifications.
S.A.E. 6145	Chromium and chromium-vanadium steel forgings, castings, structures, etc.	Chromium-vanadium specifications.

Advantages of the atomic-hydrogen arc welding process for repairing of tools and dies include:

1. Filler rod used in making the deposit can be of the same analysis as the part being welded, except that it should contain about one-third more carbon to compensate for the loss of this element in the welding process. No appreciable change takes place in other elements. Ordinarily, flux is not required.
2. The heat-treating properties of the deposited metal therefore are the same as those of the die or other parts, a feature which insures uniform composition for reworking.
3. Atomic-hydrogen produces an unusually smooth, ductile deposition free from any pin holes or impurities such as oxides and nitrates.
4. The welds produced are clean and free from scale and the work is not pitted by weld spatter. Under-cutting is easily avoided.
5. The thickness of weld depositions can easily be varied from the thinnest surfacing to a heavy deposit. Definite savings are thus afforded.
6. Small sections of cutting edges can be built up without affecting adjacent areas by scaling, under-cutting or spatter, so that reworking of the entire cutting edge can be avoided.

Atomic-Hydrogen Tool and Die Welding Rods

For the purpose of simplifying the atomic-hydrogen welding of tool steels, five general classes of welding rods, including high speed steel rods, can generally be utilized. Table I lists the most commonly used tool steel, alloy steel and low alloy steel rods for application in the atomic-hydrogen and oxy-acetylene welding methods.

Weld depositions of tool steel welding filler rods are sufficiently soft to permit machining. After machining, weld depositions should be rehardened and tempered or drawn. For this reason, it is imperative that the filler rods contain at least $33\frac{1}{3}$ percent more carbon content than would be contained in tool steel in its classification. To aid in the hardening ability of tool steel weld depositions, it is recommended that added amounts of vanadium also be utilized in the filler rods.

Typical carbon and carbon-vanadium water-hardening steels have carbon contents of approximately 1.05-1.10 and in the case of the latter a vanadium content of 0.20. The welding filler rod utilized on welding the typical water hardening tool steels should contain a carbon content of 1.35 and a vanadium content of 0.25.

Typical oil-hardening tool steels have average analyses of about 1 percent carbon, 1.20 manganese, 0.50 tungsten, 0.50 chromium and 0.20 vanadium. The filler rods utilized to weld the typical oil-hardening non-shrinkable or non-deformable steels should have a carbon content of 1.35, manganese

1.20, tungsten 0.50, chromium 0.50 and vanadium 0.45.

The typical air-hardening tool steels of the 5 percent chromium variety have analyses containing about 1 percent carbon, 0.70 manganese, 5.25 chromium, 1.10 molybdenum and 0.25 vanadium. The filler rod utilized to weld the 5 percent chromium types of air-hardening steels should contain a carbon content of 1.50, manganese 0.70, chromium 5.25, molybdenum 1.10 and vanadium 0.50.

The typical high-carbon high-chromium types of air-hardening steels have analyses approximating carbon 2 percent, manganese 0.25, chromium 12 percent, vanadium 0.80, cobalt 0.40 and molybdenum 0.80. Because these steels are most temperamental it is a problem to secure a filler welding rod having alloys properly balanced and which will produce weld deposits that can be either air or oil quenched. Filler rods should have the approximate analyses of carbon 2.50, manganese 0.25, chromium 12.00, vanadium 0.80, cobalt 0.40 and molybdenum 0.80. The weld depositions produced from this particular type of filler rod should have the ability to be either air or oil quenched.

In the case of the typical hot working tool steels, the average analyses of the most popular types have a carbon content of 0.35, silicon 0.90, chromium 4.75, molybdenum 1.40 and tungsten 1.20. The carbon content of the filler rod utilized for the welding of these types of hot working steels should contain about 0.50-0.55 carbon, the other alloys being in identical quantities. This type of filler rod could also be utilized in welding the high tungsten varieties of hot working tool steels.

High speed steel die units can be successfully repaired and compositely fabricated by the atomic-hydrogen arc welding process with typical molybdenum high speed steel filler rods. In the case of the repairing of high speed steel cutting tools it is recommended that the molybdenum high speed steel filler rods be applied by the oxyacetylene process.

Operation and General Welding Procedures

While atomic-hydrogen arc welding is decidedly different from the metallic arc welding, its operation is as simple as the metallic arc welding method. The flow of hydrogen is controlled automatically, and the welding apparatus is equipped with an indicator which registers the degree of heat being produced by the unit. The electrodes that are being used should be large enough to accommodate the current required without an excessive consumption of the tungsten electrode itself.

In the atomic-hydrogen welding process, due to the area affected by the heat of the arc, counter-acting warpage is a problem. The operator can skillfully learn to maneuver the electrode holder in a manner to minimize this effect.

JIC Hydraulic Standards for Industrial Equipment

H4—Piping, Fittings, and Fluid Passages

(Piping includes all pipe, tubing, hose and fittings. Passages include all fluid conductors other than piping.)

- H4.1.1** When requested on purchase order, a piping layout or photograph shall be furnished.
- H4.1.3** Cross sectional area of the piping shall be such that the flow capacity shall be sufficient on the suction side to prevent cavitation or starvation of the pump; and on the discharge side to prevent undue temperature rise or turbulence. Piping shall have adequate strength to withstand additional pressure, including surge pressure, within the safety limits of the entire circuit. A factor of safety of at least eight (8) over normal working pressure is suggested.
- H4.1.4** (A) Unnecessary surges shall be minimized at their sources, and adequate protective devices shall be provided in piping circuits to protect piping and fittings against hydraulic impact.
(B) The strength of the piping shall be adequate to withstand the maximum rate of surge pressure rise and the maximum surge peak pressure at the frequency developed by the cycling of the equipment operation.
- H4.1.5** Piping leads in working circuits between actuating devices and feed control devices shall be so constructed as to rigidly confine a minimum volume of fluid, the purpose being to maintain constant, controlled motion and restrict the effect of varying forces.
- H4.1.6** (A) Solderless pipe connections shall be used (for example: flared, flareless, self-flaring, flanged, or equivalent).
(B) The performance of any type of fitting used shall equal or exceed the requirements of AN-F 47.
(C) When flared type fittings are used (which require a flaring tool), the angle of flare of tubing shall be 37 deg from the centerline, 74 deg included angle, and flare dimensions shall be in accord with Army-Navy Design 10061.
(D) When flared type fittings are used, the construction of the tube end (i.e. tubing end of connector body, nut, and sleeve when used) shall conform to joint Army-Navy Specification AN-F 366 for minimum performance requirements. Modifications may be used if performance conforms with the requirements of sentence (B).
* (E) All pipe threads shall be Dryseal American (national) standard taper pipe threads (N.P.T.F.).
(F) Fittings with straight threads and which incorporate seals that seal with pressure may be used in place of pipe thread fittings.
(G) All piping connections shall be so designed and installed as to permit quick removal and re-assembly by means of hand tools.

Definition of Pressures

Low	—	0 to and including 200 psi.
Medium	—	Above 200 to and including 500 psi.
Medium high	—	Above 500 to and including 1200 psi.
High	—	Above 1200 to and including 3000 psi.
Extra high	—	Above 3000 psi.

1. Tubing outside diameter sizes shall increase in $\frac{1}{16}$ in. increments from $\frac{3}{8}$ in. to and including $\frac{3}{4}$ in., and in increments of $\frac{1}{8}$ in. above $\frac{3}{4}$ in. diameter up to and including 1 in. diameter and in $\frac{1}{4}$ in. increments above 1 in. diameter.
2. SAE 1010 dead soft, cold drawn seamless steel tubing or equivalent and steel fittings shall be used.
3. Copper tubing or copper alloy fittings are not permissible with petroleum base fluids.
4. Fittings with restricted or stepped-up passages are not recommended.

*(See note: Engineering Developments)

H4.1.7 All piping, piping fittings, oil passages, reservoirs, cored holes or drilled holes must be free of burrs, or foreign matter which might cause damage to any hydraulic unit or contamination of the hydraulic fluid. Sharp edges shall be removed whenever they adversely affect the flow of hydraulic fluid.

H4.1.8 Whenever practicable, each piping run must be integral and continuous from one piece of apparatus to another. Piping runs must be removable without dismantling equipment components and without bending tubing or springing it in a manner to damage it. All rigid piping must be securely supported at frequent intervals to avoid vibration or movement. Points of contact or support on the outside of the piping shall be so designed that they will not result in damage to the piping. Piping shall not be welded to supports.

H4.1.9 When high or extra high pressure piping is used all connections shall be welded to steel flanges; or connections may be used which are equal in performance and ease of assembly. Flanged connections shall use sealing devices that seal with pressure (all welded joints shall be stress relieved).

H4.2.4 All portions of piping circuits above 150 psi operating pressure subject to movements in which flexible hose is required, the flexible rubber hose shall be fabricated to a pressure safety factor of at least five (5) with respect to the circuit in which it is used. Below 150 psi operating pressure, the use of plastic tubing shall be permissible. Flexible hose and plastic flexible tubing shall have vertical connections and shall have sufficient slack to avoid sharp flexing and straining. Horizontal connections are acceptable only if tubing is adequately supported.

H4.2.5 Multiple controls shall be mounted on a single plate within one enclosure, whenever practicable to eliminate excessive piping.

H4.2.6 Piping shall not be placed where it will interfere with the adjustment, repair or replacement of control or units, and piping connections shall be readily accessible for maintenance.

H4.2.7 Hydraulic units provided with external drain connections shall be drained independently to reservoir or to a vented manifold.

H4.4—Identification of Piping

H4.4.1 Piping runs shall be identified to correspond with diagram.

H4.4.2 When construction of equipment necessitates shipment or moving in sections, thorough precautions shall be taken to adequately protect piping runs, whether they be left in place on one of the equipment sections or whether they are removed and separately boxed for shipment. All male threads shall be sleeved, and all piping openings or female threads equipped with suitable closures.

H4.4.3 Piping shall be so arranged that pressures may be tested at accessible locations, preferably at built-in checking stations which shall be indicated on diagrams.

H5—Oil Reservoirs

(Separate or Integral with Machine)

- H5.1** A hydraulic fluid reservoir shall be designed, and constructed in such a manner as to prevent the entrance of any foreign matter, chips, coolant, lubricating or cutting oil, dirt, etc. Fluid reservoirs should preferably be made separate and removable from equipment bases. If cast, fluid reservoirs must be impregnated and sealed before assembling into equipment, with a sealer which is inert to hydraulic fluid. This must be tested by means of light petroleum solvent. If welded, welds must be tested with light petroleum solvent.

JIC Hydraulic Standards for Industrial Equipment

(Continued)

H5.1.1 The filler hole shall have a fine mesh screen, removable for cleaning and replacement, for straining the oil when filling, and shall be provided with a well fitted cap or cover permanently attached to the reservoir by some suitable means.

H5.1.2 A breather hole properly protected by an air cleaner shall be provided. The breather and filler must be separate and have sufficient capacity to permit rapid filling. The air cleaner must also be of sufficient capacity to maintain approximate atmospheric pressure at maximum circuit demands.

H5.2 The capacity of the fluid reservoir shall be sufficient to contain all of the fluid that will drain from the system back into the tank by gravity flow; maintain the fluid level within a reasonable working height during operating cycle; dissipate heat generated by normal operation of the equipment; allow air and foreign matter to separate out of the fluid.

H5.2.1 The reservoir shall be equipped with a flush-mounted or protected fluid level indicator, preferably located near the filler cover. It shall be provided with markings to show high and low levels with pump running and, where necessary, high level with pump stopped.

H5.3 Both the intake and return pipe shall be brought down below the minimum working fluid level so as not to cause cavitation or aeration.

H5.3.1 Suitable means shall be provided between the intake and return pipes to facilitate settling out of foreign matter in the fluid. The intake and return pipes shall not be located in a manner which will interfere with the efficient operation of the hydraulic system.

H5.4 Ample and accessible provisions shall be made for complete cleaning of the reservoir.

H5.4.1 A well protected, accessible means shall be provided to empty the reservoir without spillage.

H5.5—Heat Exchangers

H5.6 The use and application of heat exchangers shall be subject to approval by the purchaser.

H5.6.1 It shall be the responsibility of the purchaser to advise supplier incorporating the heat exchanger in the equipment of any unusual temperature that would affect the equipment operation.

H5.6.2 The heat exchanger must be readily accessible for removal, in the event servicing or repair is necessary.

H5.7 The heat exchanger shall be so arranged that it is not possible to develop excessive pressures in the event the heat exchanger should become clogged.

H5.7.1 Heat exchangers using media which are deleterious to the system's hydraulic fluid shall not be installed in fluid reservoirs.

H5.8 The make, size, capacity, and requirements of heat exchangers (including supply-pipe sizes) shall be agreed to by the purchaser, and shall be clearly indicated on hydraulic diagrams.

H5.9 Accessible arrangements shall be provided for checking inlet and outlet temperatures of the hydraulic fluid if circulating type heat exchangers are used.

H5.10 When heat exchangers are used, they shall be equipped with suitable automatic thermal controls.

H5.11 Heat exchangers shall not use copper or copper alloyed metals in contact with uninhibited petroleum base fluids, when these metals are incompatible with such fluids.

H6—Valves, Accessories, and Devices

H6.1—Filters

H6.1.1 Means shall be provided for the continuous removal of deleterious materials from the hydraulic fluid which would be detrimental to the operation of the equipment.

H6.1.2 If the filter is of such design that it will remove anti-foam agents or other additives, the type and design of the filter shall be agreed upon between the supplier and purchaser.

H6.1.3 Self-cleaning filters shall be automatically actuated.

H6.1.4 Filters shall be of such construction that the filter medium can be removed for cleaning without disturbing the piping. When available, suitable means shall be provided to indicate when filter should be cleaned.

H6.1.5 When suction strainers are provided they shall be of ample size to strain more than double the intake capacity. Suitable means shall be provided to remove strainers without draining the reservoir.

H6.1.6 By-pass filter must be of sufficient capacity to filter the equivalent of all hydraulic fluid in the system within a period of eight (8) hours.

H6.2—Sealing Devices

H6.2.1 All sealing devices must be of such materials that they will not be adversely affected by hydraulic fluid. Natural rubber shall not be used with petroleum products.

H6.2.3 Sealing devices on reciprocating or rotating shafts shall prevent all leakage, except that required for lubrication of such devices under all working conditions without damaging shafts.

H6.2.4 Holes in sealing glands shall be of such size as to prevent undue extrusion of the sealing material.

H6.2.5 Stuffing boxes for automatic packing shall be so designed as to prevent adjustment beyond the functional limits of the packing.

H5.2.6 Whenever practicable, heads, slides, and actuators shall be so designed to facilitate easy replacement of continuous ring packings.

H6.3—Cylinders and Pistons

H6.3.1 Cylinder bores having fitted pistons shall be finished in a manner consistent with the type of service intended and shall be free of porosity or other defects.

H6.3.2 Cylinders shall be located in alignment with work slides, and shall be such that no side or radial load shall occur on piston rod or ram, unless other suitable provisions are made to take such loads.

H6.3.3 Ends of cylinders shall utilize sealing devices that do not leak under any working conditions. Sealing devices that seal with pressure are recommended. All cylinder external sealing devices shall be readily accessible for servicing.

H6.3.4 (A) Cylinders shall be accessible for servicing.

* (B) Cylinders shall be separate, not cast integral with equipment.

H6.3.5 Pistons utilizing sealing devices which are not integral with the piston shall have automotive step-cut rings or equivalent in performance. Exceptions are permissible only for applications where no leakage (other than required for lubrication) can be tolerated.

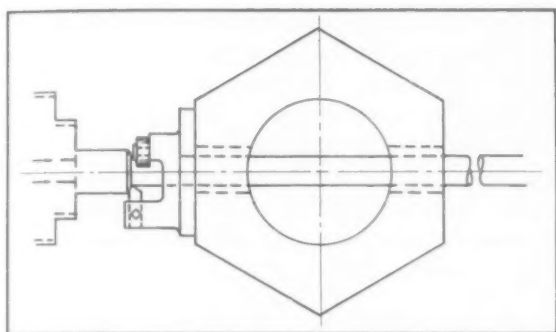
H6.3.6 Piston rods shall be adequately protected by installation of cleaning and sealing devices. Material and hardness of piston rod shall be such as to prevent scoring.

Engineering Developments

Standards specifications noted with an asterisk (*) were written as a guide in indicating the type of engineering that is considered to be desirable in new developments and in the re-engineering of equipment.

Box Turning of Bar Stock

When need arises for a quantity of odd-diameter bar stock, the emergency can be met quickly by turning it on a turret lathe, utilizing a conventional roller turner. A full-length, standard size bar can be turned down to the desired special diameter in "passes", that is, by turning down a length of bar to the extent of the turret travel, retracting the turret, chucking out additional stock and repeating, allowing the finished end to pass completely through the turret.



Long bars may be resized by turning with a traveler type box tool and turning in "passes," with the bar going through the holes in the turret, as shown in Fig. 1. The method can also be applied to engine lathes, as suggested by the inset sketch.

This method is not confined to turret lathes only. With the roller turner mounted in a suitable adaptor on the compound of a regular lathe the same procedure can be carried out, using the normal carriage feed. Here, however, it is recommended that a flood coolant be supplied to the tool to prevent loss of tool edge and consequent loss of tolerance and finish. The compound and cross slide must be securely locked in position so as to not to "lose center" once the roller turner is located.

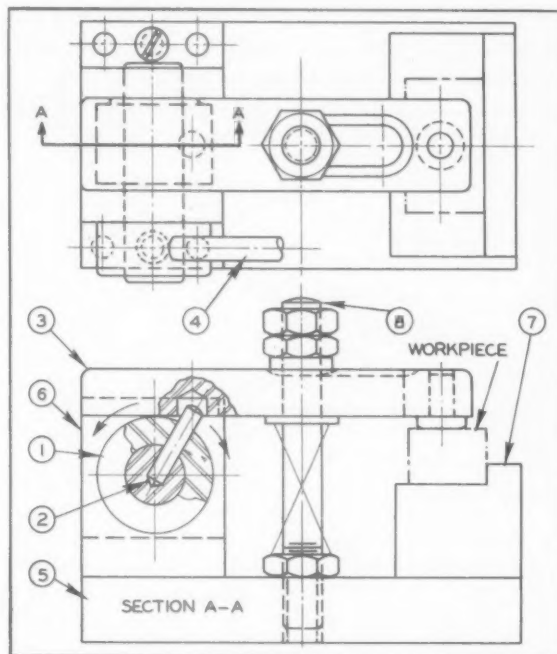
In rechucking the work for a new pass all that is necessary is to release the feed, loosen the collet or chuck and return the carriage for a new pass, the work generally being held in the roller turner sufficient to carry the bar along with it.

The initial cut on each bar must be made on a stubby chucking so as to establish "size"; also, the last chucking will most likely necessitate withdrawing the full length of the bar back through the headstock.

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Lockport, N. Y.

Quick-Acting Clamp

The quick-acting clamp illustrated operates on a simple principle. A lever-operated cam, 1, has a pin 2 which engages a partly drilled hole in the strap 3. With the strap retracted, a clockwise turn of handle 4 causes the pin to engage the hole and move the strap forward and over the workpiece.



A pin, in the cam, engages a partly drilled hole in the clamp strap. With a clockwise turn of the cam, the pin engages the hole and carries the strap over the work and clamps it. A counter-clockwise turn of the cam unclamps and retracts the strap.

At that point, the pin clears the hole and further motion of the lever clamps the strap against the workpiece through the rise of the cam. On counter-clockwise motion of the lever, the pin re-engages the hole and retracts the strap clear of the workpiece.

Otherwise, design is conventional. Other details are numerically designated as follows: Detail 5, the fixture base; and 6, 7, and 8, the cam bearing blocks, the work-locating anvil, and stud with components, in that order.

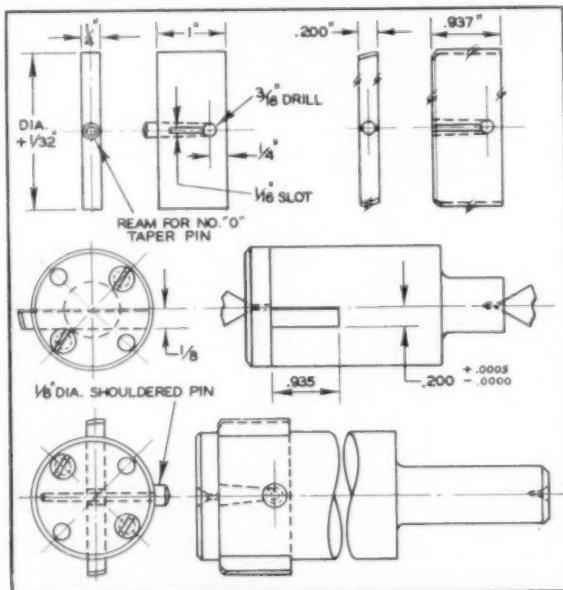
Cliff Bossman
Dayton, Ohio

The Tool Engineer pays regular page rates for accepted contributions to these pages, with a minimum of \$5.00 for each item.

Low-Cost Reamer

The reamers and holders illustrated were designed by the writer for use in a jobbing shop specializing in manufacture of gears in small lots. Hole sizes ranged from 1 to 6 in. In addition to a low first cost, these reamers produce a smooth, round hole and have the further advantage of being expandable up to about 0.006 in.

The blades are made from $\frac{1}{4} \times 1$ in. high speed steel cut $\frac{1}{32}$ in. longer than the required hole diameter. A $\frac{3}{16}$ in. hole is drilled $\frac{1}{4}$ in. from one edge. Another hole, breaking into it, is drilled axially on the center line and reamed for a No. 0 taper pin. The blade is then slotted part way as shown in Fig. 1. A taper pin is driven lightly into the tapered hole, with about $\frac{1}{8}$ in. projecting.



The reamer described consists of a floating blade and a holder. Fig. 1, at upper left, shows the blade after preliminary machining and hardening. Fig. 2, upper right, the blade after grinding; Fig. 3, center, the arbor for grinding circular relief, and Fig. 4, bottom, the reamer body or blade holder.

The blade is then hardened and ground to 0.200 in. thick and 0.937 ± 0.005 in. wide, as shown in Fig. 2, upper right. The slot, which was previously ground part way to prevent cracking during hardening, is then extended out to the end and the taper pin ground off flush with the leading edge. On reamers $2\frac{1}{2}$ in. or over in diameter only the cutting edges are hardened and the machining operations done afterward.

The circular relief is next ground, as shown in Fig. 3, center. Here, the blade is inserted in a grinding arbor provided with a 0.200×0.0935 deep slot, which is $\frac{1}{8}$ in. off center, and clamped by an end plate. The arbor is then mounted on centers on a tool grinder, and the relief ground and chamfered. The blade is then reversed and the

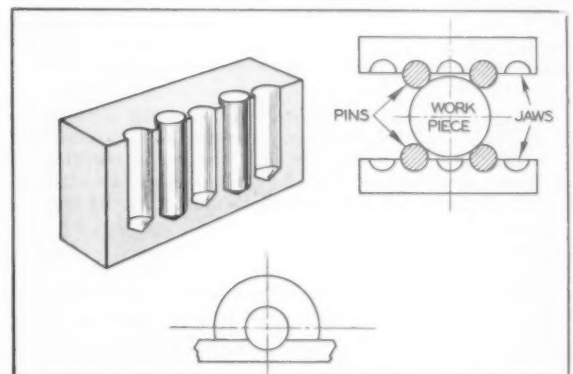
opposite edge ground, care being taken to maintain the overall cutting diameter.

The reamer body or holder, shown in Fig. 4, bottom illustration, is made in suitable diameters to accommodate the required number of blades in a given range. Its construction is closely similar to the grinding arbor, the shank being turned to fit the holes in the turret tool holder. The blade is a slip fit in the slot, for sideways float, and is retained by a $\frac{1}{8}$ in. diameter shouldered pin through the previously drilled $\frac{3}{16}$ in. hole. The reamer blade can be expanded or contracted by driving the tapered pin in or out from its seat.

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Vise Jaws for Rounded Workpieces

Easy-to-make vise jaws, such as illustrated, greatly facilitate the holding of round, rounded or odd-shaped workpieces. The jaws are equally suited for bench or machine vises. The jaws, made in pairs, have closely spaced half-holes in which pins are placed. As the vise is tightened, the workpiece adjusts itself between four pins—or, where shape requires, between three pins angularly located.



Round or irregularly shaped workpieces may be held the more securely by means of pins held in half holes drilled into the vise.

A simple way to make the jaws is to clamp two pieces of steel together, the width and length being suited to the vise in which they are to be used. Holes $\frac{3}{8}$ or $\frac{1}{2}$ in. diameter are then drilled into the mating faces, creating the halfholes. By not drilling quite through—as for bench vises—the pins are kept from falling through the holes.

If used for long production runs, it is suggested that the holes be drilled with their centers slightly in from the face of the jaws, to retain the pins, as indicated by the lower sketch. To do this, a strip of steel may be clamped against the jaws, during drilling, to be discarded after drilling. This obviates later milling.

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Elements of Resistance Welding

By A. E. Rylander

THE SUBJECT MATTER for this report has been chosen for its timeliness since, as in World War II, welding is destined to play an important role in the present defense program. To that end, and in line with the basic purpose of these *Tool Engineering Reports*, this manual on resistance welding will embrace methods and equipment broadly applicable to the general run of production welding rather than to any one particular application of class of work.

As the term implies, resistance welding effects union of metallic components as a result of local resistance, at the point of juncture, to

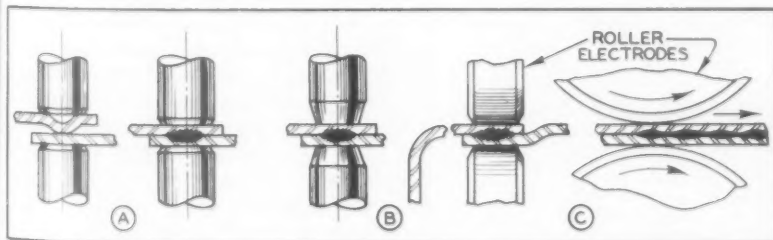
the electric current passing through them. Heat, concentrating at the point or points of contact, almost instantly generates welding heat; then, applied pressure solidly fuses the components together. The basic elements of resistance welding are further explained in the several illustrations.

Resistance welding may be subclassified as follows: projection welding, spot welding, seam welding, press welding and flash welding. While alike in principle, and while their applications may overlap in some instances, the equipment for each is designed to function within a range limited by the nature of the

work, the composition of the material being welded, its thickness or cross-sectional dimensions, and the shape of the parts among other considerations.

Thus, projection, spot, seam and press welding are usually applied to sheet stock or parts made from sheet stock, while flash welding may be applied to end-joining of sheets, strips, tubing rods and bars through to forgings. Practically all of the ferrous metals may be resistance welded, stainless included; also such non-ferrous metals as monel, brass, aluminum and magnesium. Where, however, the ferrous metals usually call for alternating current, some of the non-ferrous metals may require use of direct current.

In projection welding, shown at *A*, one component has projections or "bumps" at which welding heat localizes. In spot welding, *B*, fusion occurs between the components along the centerline of the electrodes. Fusion occurs progressively between roller electrodes in seam welding, shown at *C*.



Finishing Advantages

A particular advantage of resistance welding is that it obviates use of welding rods, fluxes, and all but the most nominal preparation for successful application. Except for flash welding, which raises a flash requiring subsequent trimming, it leaves a smooth surface devoid of weld spatter, scale or other surface defects. Another advantage is that it can be performed with unskilled

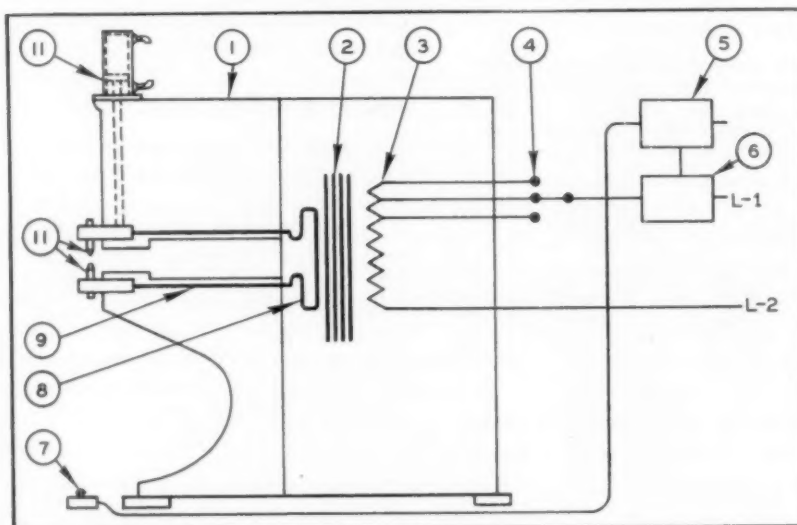
labor; as a result, women are coming into the welding picture in increasing numbers.

Still another advantage is that the equipment is self-contained. The essential elements of a resistance welder are the machine itself, the electrical controls, the copper—or copper alloy—electrodes, and means to apply pressure on the work by the electrodes, the latter also known as “dies” or “guns”. The pressure medium can be air, fluid or mechanical. With these elements in mind, we will discuss the several sub-classifications in some detail and in the order introduced above.

Projection Welding

In projection welding, one of the components—usually the thicker of the two—has a bumped-out “hump” or projection for localization of welding heat. When welding the parts, this projection is centered between the electrodes of the welding machine. As the mating surfaces become incandescent the components are pressed together by the electrode until the main surfaces are in tight contact, when the weld is completed. The entire cycle is instantaneous to all practical purposes.

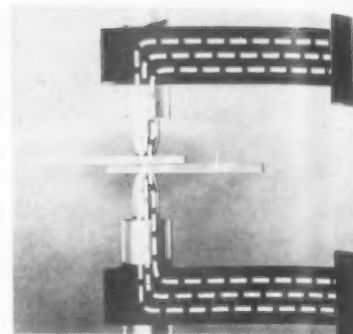
Elements of typical resistance welder. At 1 is the housing; 2, the low-voltage, high current transformer; 3, primary coils; 4, tap switch; 5, welding timer; 6, power interrupter; 7, foot switch; 8, secondary loop; 9, bands from electrodes to secondary; 10, electrodes; 11, cylinder which exerts electrode pressure on work.



As may be inferred from the term, spot welding implies one or a series of spotted welds of comparatively small diameter and proportionate to the diameter of the electrodes. Except that the main surfaces are in contact at the start of the weld, and that the heat localizes directly on these surfaces in line with the electrodes, rather than at the projection, the principle is the same as for projection welding. The equipment for either may usually be used interchangeably since in both cases—in all cases of resistance welding, for that matter—the welds are made under pressure.

Analogous to Riveting

Because it serves the same basic purpose, spot welding may be considered as broadly analogous to riveting, yet having the advantage that there are no holes to drill or rivets to insert. On certain application, therefore, and especially in the case of thin sheet stock where the metal may rupture before the weld pulls apart, spot welding is considerably faster and consequently less expensive than riveting. Since, however, the choice between the two would depend largely on the nature of the assembly and the thickness and



Above, the flow of alternating current in resistance welding.

composition of the material, this statement may need to be qualified.

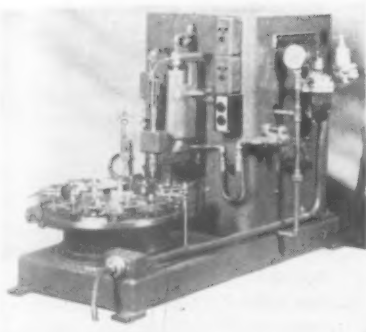
Assume an assembly comprised of a formed stamping and a cover plate of 16 gage steel which, to join, would require twelve rivets or twelve spot welds. Further assuming that either operation would be performed automatically with multiple guns all acting simultaneously, and that the basic design and timing of either machine would be closely alike; then, neither method would show any appreciable saving over the other as far as the actual joining is concerned. Output of either would be 200 or more per hour. However, the riveted joint would entail punching holes and inserting rivets, plus extra handlings; therefore, the greater overall saving would be effected by spot welding.

Portable Welders

Further analogous to riveting, spot welding may be done on presses or with portable guns which, superficially, compare with the alligator, scissors or C-type frames of portable hydraulic riveters. Just as the dies of a riveter close under hydraulic pressure, so the electrodes of a welding gun close under air or fluid pressure. Usually, however, the latter is used only when required electrode pressure exceeds 600 lb. the ordinary rated capacity of standard air-operated welder guns.

The essential elements of a portable gun welder are the same as for resistance welding in general, as described above, the main difference

Tool Engineering Report



This air-operated, 12-station dial feed welder assembles small electrical parts at speeds up to 1000 units per hour.

being that the "gun" itself is detached from the main unit. Air, and water for cooling, are supplied at nominal line pressures; when, however, hydraulic pressure is required, an air-hydraulic booster is mounted on the transformer.

Seam Welding

Whereas projection and spot welding effect junctures at spaced intervals, seam welding produces what to all practical purposes is a continuous, tight seam. Otherwise, the principle is the same as for projection and spot welding, the main difference being that roller electrodes are used. It might be explained, however, that penetration of welding heat fluctuates in direct ratio to the cycle of the alternating current and the speed of the work-piece through the roller electrodes. Thus, the penetration will be deeper at the points of current surge although the generated heat would tend to bridge these gaps. That is unless it is desired to space the welds, which can be done with timing the power surges.

The weld may be longitudinal, as for the lengthwise seam of a range boiler or similar units, or circular, as for the welding of the bottom to the cylinder. Or, it may be of indefinite length, as in the welding together of strip stock or long pressed steel channels or shapes. Among the more unusual applications may be mentioned the seam welding of cylindrical filter screens.

Because the electrodes are in con-

tact with the work for a considerable interval of time, as compared to the more or less intermittent operation of spot welders, cooling is a "must" in seam welding. This may be done in two ways: by circulation of water through the electrodes or—as per usual practice—by flood cooling applied externally.

Considering that at least one of the electrodes is power driven, internal cooling naturally involves provision to prevent leakage around the bearings although, in the majority of cases, this would have no deleterious effect on the weld. Where internal cooling is used, the wheels proper may be cored out and rims pressed onto them. The latter, rather than the wheels themselves, are interchanged should electrodes of different face width or shape be required.

Simple Guides Used

The tooling for seam welding is usually, but not always, designed along comparatively simple lines and consists mainly of providing

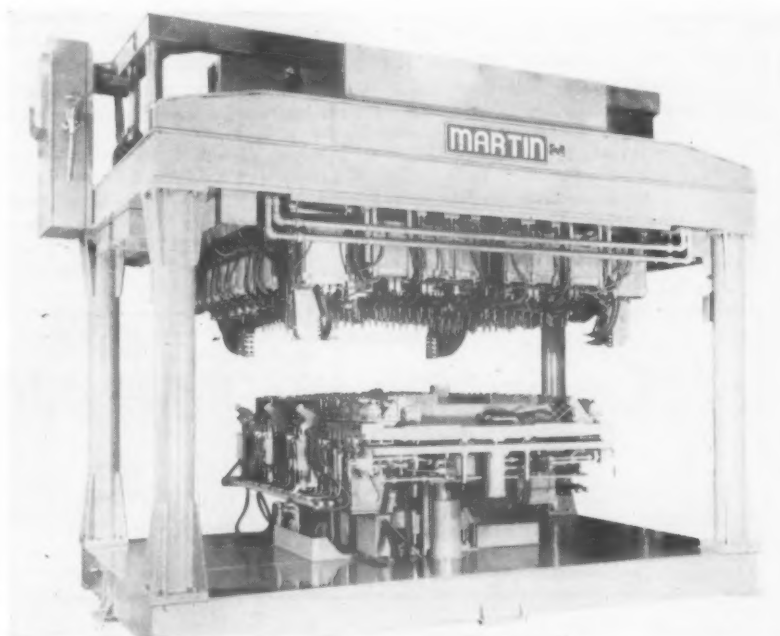
suitable guides or cradles for the parts being welded. Should one decide to seam weld continuous strip, for example—and this would be a rather unusual application—it would not be necessary to provide roll feeds as in punch press operation, since that function would be performed by the rotating electrodes. One would merely provide strip-guides, a coil stand and, possibly, a coiler. However, tooling will be discussed later in this report.

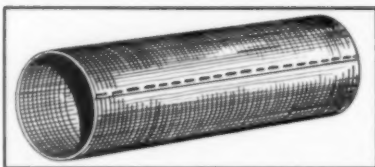
Press Welding

Embracing spot welding, but on a more ambitious scale, press welding may be likened to punch press operation in reverse. That is, instead of forming metal or punching holes, it joins previously formed metallic components in size ranges running from small assemblies, having multiple welds, to complete automotive side panels, roof and underbody sections to fender assemblies.

The method employs a press, comparable to a punch press in its oper-

Hydraulically-operated press-type multiple spot welder designed for automotive production. Welder spots 212 welds simultaneously with a balanced load across a 3-phase system. Lower die is then indexed to make another 212 welds. Production is about 175 assemblies/hr.





The filter screen above is a good example of high production seam welding of small parts. Screen is made on a roll-type seam welder.

ation and small or large depending on the size of the assembly and further involves die sets incorporating anywhere from a few to several hundred electrodes or "guns." In nicety of design and workmanship, these multi-electrode welding units will compare favorably with precision engineered punch press units, the main exception being that the limits of tolerance between electrode centers are somewhat more flexible. This, of course, is due to the fact that the "punches" do not have to enter the mating "dies."

Press Welder Tooling

While superficially complicated, in view of a multiplicity of wiring and manifolding incidental to water cooling, the tooling for one of these die sets is essentially simple. The individual guns are comparable to standard hole punching units and, like them, may be spaced in any order to suit a specific pattern of weld spotting. Like hole punching units, they are also salvable and in-

terchangeable; consequently, the die sets may be reworked to suit model changes. However, design and manufacture of these die sets is a specialty; as such, they are factory built although the user plant may have a department devoted to their servicing and reworking.

On the whole, fixtures for press welding are patterned along simple lines and consist mainly of rest pads and locating points for positioning of assembly components. When required by the nature of the assembly, a judicious disposition of holders and clamps may be necessary although, once the electrodes are brought into contact with the workpiece, the air pressure is usually sufficient to solidly clamp the parts together. In the majority of cases, the fixtures may be skeleton weldments made up of structural shapes and steel plate.

Flash Welding

In addition to the other essential elements incidental to resistance welder design, the conventional flash welder embodies a stationary and a movable platen although, in special case, both platens may be movable and may further include rocking heads. These rocking heads are necessary to permit head-on insertion of such items as tubular bent shapes, such as metal chair frames, to cite an example. The electrodes, of copper or copper-alloy, also serve as fixtures. Like the smaller electrodes used for spot welding, they are water cooled—here a stark ne-

cessity due to the high heat generated during a comparatively protracted welding cycle.

In welding, the component parts are loaded into the fixtures with the platens in retracted position. The movable platen then advances in rapid traverse to near contact of the parts, slows until their ends meet, under pressure, when the abutting surfaces flash to incandescence. The movable platen then advances under pressure to impart a final "squeeze." After a momentary dwell, to permit the weldment to coalesce, the ram recedes to loading position. The cycle repeats.

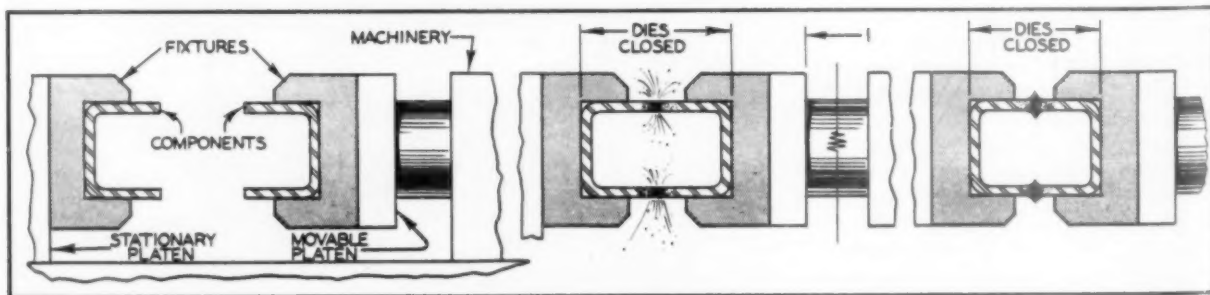
End Preparation

When flash welding tubing, sheet or solid bars, it is usually necessary to bevel or otherwise prepare the abutting ends, as illustrated on the schematic diagrams. Forgings, too, may require prior preparation; however, it is not usually necessary to prepare the ends of pressed steel parts made of comparatively thin stock.

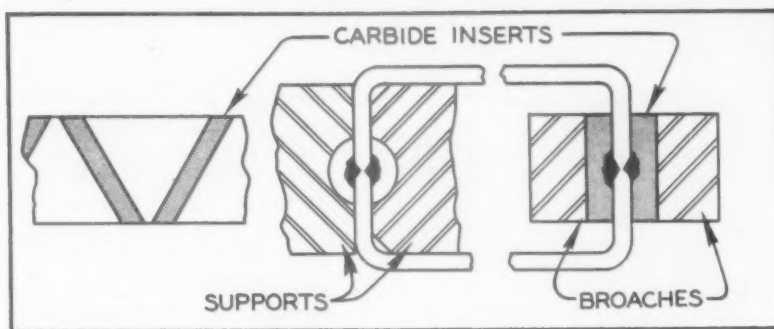
As compared to spot or seam welding, which leaves the surface smooth, flash welding raises a considerable flash which, in the majority of cases, must subsequently be trimmed. On symmetrical parts, as where the point of juncture is in line, this is done in a flash trimmer. Internal flash lines may be removed in a flash trimmer.

In certain cases, it may be advantageous to trim the flash immedi-

In flash welding, parts are loaded on fixtures, one of which is mounted on the stationary, and the other on the movable platen of the welder. Movable platen moves until parts meet, then current is applied. A final squeeze is imparted, then after short pause movable platen retracts to loading position. Flash is subsequently trimmed off in a flash trimmer.



At right is a tool setup applicable to flash trimming a weldment such as that shown on page 70. Since parts were trimmed immediately after welding and while still plastic, they were supported against cutter thrust as indicated. Broach teeth were inset at alternate 30 deg angles on the broaching bar.



ately after the part is discharged from the welder. The reason is that, once it has cooled, surface scale may be so hard that the trimming cutters become dulled after a few passes; however, this can be obviated to some extent by trimming slightly below the surface metal—that is; where the nature of the work so permits.

Naturally, trimming while hot entails complications, especially so in the case of tough alloy steel weldments. For one thing, the part will be at red heat—from 1000 to 1300 deg F—and therefore heat-plastic and subject to distortion under cutting thrust. The hot metal will also tend to weld itself to the cutting tools. What with heat and all, this condition is destructive to the trimming tools.

In this connection, we are reproducing an illustration of a trimming tool taken from "Practical Application of Carbide Tools," December

1950 issue, *The Tool Engineer*. This tool, as shown above, is aptly applicable to trimming the flash from the part illustrated in the diagram on page 70. This is a broaching tool, with insets of a special grade of carbide angularly spaced, in a broaching bar, to produce a shear cut.

Hot Trimming

The part is supported against broaching thrust and the trimming is done in two passes. Here, however, it makes no difference which of the flashes—inside or outside—is trimmed first as long as both are done while the part is still hot. It may be remarked that the tool illustrated stood up for an entire shift, at a high rate of output, and even then required only nominal resharpening.

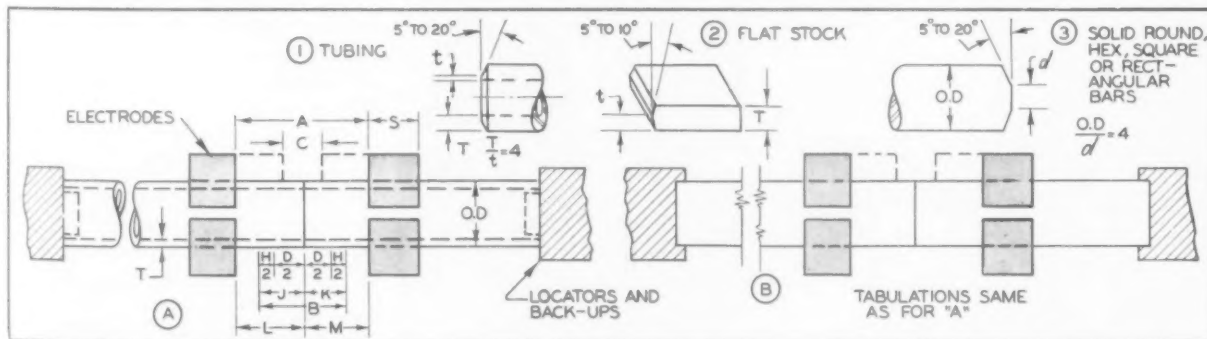
The value of shear cutting, whether for cold or hot flash trimming,

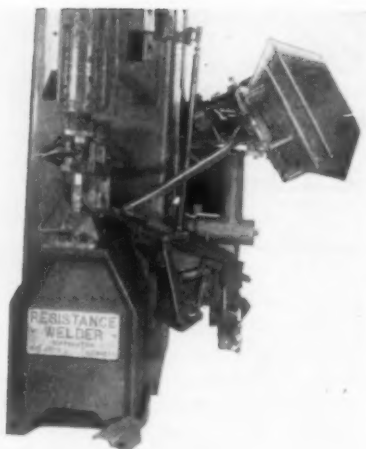
cannot be over-estimated. For one thing, it slices the flash rather than gouges, as teeth set crosswise would do; therefore, it considerably reduces the tendency to tear. In addition, the angular setting of the broach teeth tends to push adhering metal to one side; thus, the teeth are self-cleaning to all practical purposes. Alternating their angular relation, as shown, cancels out the excessive side thrust that would occur with teeth angled in one direction.

Accessory Tooling

While welding machines cannot be classified as machine tools *per se*, their overall efficiency—like that of machine tools—may be considerably enhanced through use of auxiliary tools and appliances. For example, magazine and hopper feeds may be used to feed smaller, selected parts and to accurately position them on mating parts.

At left, a diagram of flash welding tubing and flat sheets. Key to symbols: *A*, initial die opening; *B*, material lost; *C*, final die opening; *D*, total flash-off; *H*, total upset; *J* = *K*, material lost per piece; *L* = *M*, initial extension over workpiece. *OD* is outside diam of workpiece; *S*, minimum length of electrode contact. On details 1 and 2, when *T* is 3/16 in. or more, bevel one workpiece. At right is flash welding of solid bars. Tabulations are same as at left. On detail 3, recommended end preparation is to bevel one workpiece on bars 1/4 in. OD or larger.





This hopper feeder, used by a producer of pressed steel parts, feeds and positions clinch nuts into pressed steel components as fast the operator can load and unload. Feed rate is integrated with the welder.

Thus, the operator need only handle the main component and position it under the electrodes, thereby materially reducing the time otherwise required to handle and sub-assemble several parts. While the hopper illustrated is a special design for feeding and positioning clinch nuts into pressed steel components, standard hoppers may be advantageously used for selective feeding of small symmetrical parts.

Magazine and hopper feeds may further be used in combination with

dial feeds for even greater saving of time; however, the time interval between index cycles is usually sufficient for loading of one or several parts. In the manufacture of automobile frames, for example, dial feeds in combination with vertical flash welders are used to weld-assemble such items as body brackets. The component parts are manually loaded but automatically ejected, all at a high output rate. Dial feeding is particularly applicable to production welding in the electrical industry.

Tooling Recommendations

As previously stated, tooling for resistance welding is patterned along simple lines, and in many cases involves nothing more than the machine and its electrodes. The work can be held by hand. And even where fixtures and holders are required, each job calls for its peculiar design.

However, the same general principle of good tooling practice that apply to metal processing in general are also applicable to resistance welding. With some variations, these principles may be covered in the following recommendations:

Keep all magnetic materials, such as iron and steel, out of the throat of the welding machine; also, insulate all gage pins, clamps and other details. Protect moving slides, index pins, and all accurate adjusting or

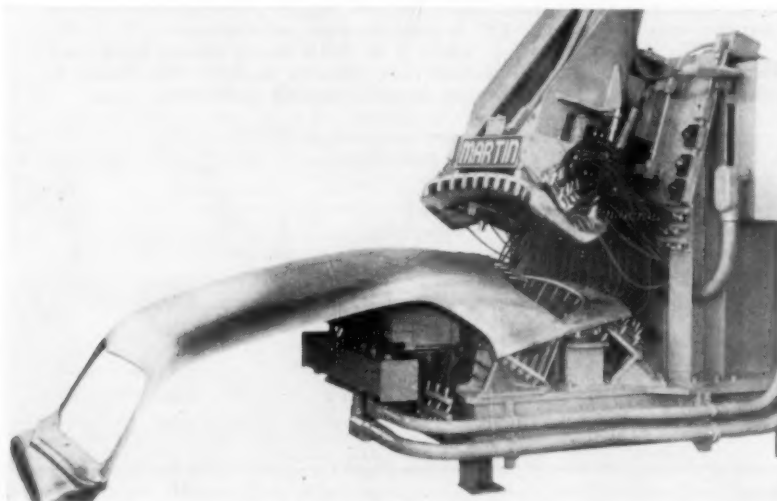
locating devices from flash. In addition to insuring that the fixture is correctly designed for the job, give due consideration to ease of operation and safety for the operator.

Where the work tends to stick in the fixture, or to the electrode faces, provide knockouts or strippers. These add to operator convenience and further boost output. Because stationary parts are affected by the magnetic field of the machine, work-holding parts and clamp handles should be of non-magnetic material to prevent movement or heating due to the magnetic field.

With regard to the machine, keep the throat as small as possible to do a given welding job. Make all electrodes readily replaceable, and provide sufficient water cooling to prevent overheating. As far as possible, water cool them close to the tip. Provide adjustment for electrode wear; also, check welding pressure application. In all cases, provide current-carrying members of adequate cross section, and run as close as possible to the electrodes; also, use the fewest possible joints or connections in the secondary circuit.

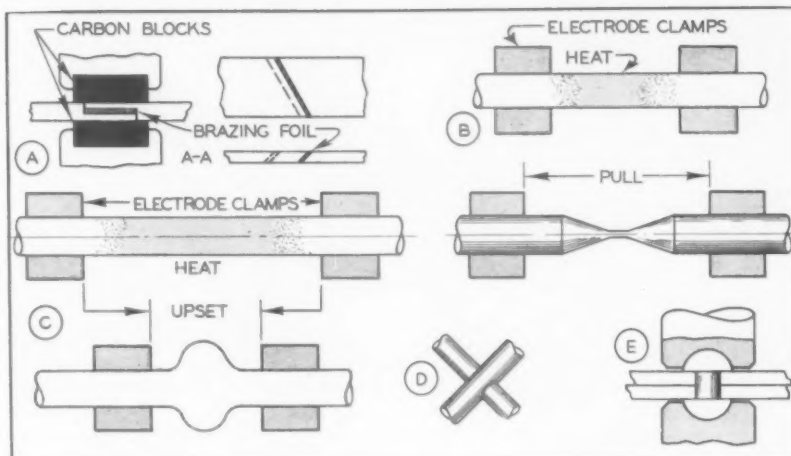
Feeding Problems

Because the resistance welder is a high-production tool, it is essential that provision be made for rapid feeding of parts and equally fast disposal of the finished weldments. Here, however, one works under a certain handicap as compared to punch press operation. For while the latter permits stacking of blanks and nesting of formed stampings, these may be so encumbered with interferences after welding that orderly stacking is practically if not entirely impossible.



Automatic multi-spot welder at left welds rear window reinforcements to roof panel, making 60 welds on each assembly. Unit is hydraulically operated.

Some other applications of resistance welders. At *A* and *AA* is electro-brazing, with carbon blocks replacing copper electrodes. At *B*, electro-working, in which rod is heated and pulled to produce pointed ends. Electro-upsetting is at *C*, and electro-forging at *D*. Electro-riveting, in which rivet is heated and headed under pressure, is at *E*.



Then too, the weldments come out hot and may have to be handled with tongs, a further deterrent to orderly stacking. Therefore, the usual practice is to chute them into tote boxes which may then be removed by truck or crane lift. Such disposal is entirely practical considering that the heated state of the weldments precludes immediate second-operation work.

It often happens, however, that weldments may have to be stress annealed immediately after welding; then the practical thing is to chute them directly onto a conveyor which in turn transports them to the annealing oven. In any event, forethought must be directed toward materials handling and a plant layout that, as far as possible, at once precludes bottlenecks and provides a free flow of material.

Applications Unlimited

From the foregoing, it can be inferred that the applications of resistance welding are practically unlimited; in fact, it may be considered as the most universal of all methods for metal processing. Fur-

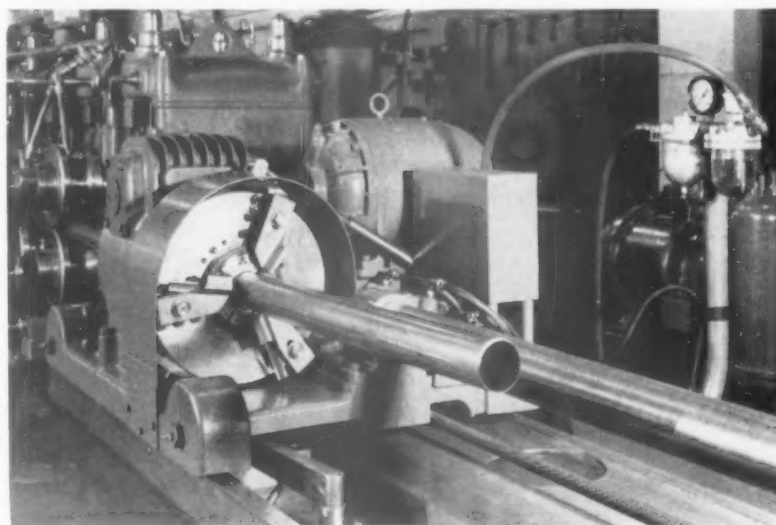
thermore, one has recourse to a wide variety of equipment, and while much of the standard equipment overlaps in its functions, one may also avail oneself of special, single-purpose machines designed for specific applications.

Welded Weave

The uninitiated, for example, might not readily associate welding with weaving; however, special machines for manufacture of wire fabric and screen will compare favorably in both output and quality of product with textile looms. A machine of this type is shown on page 74. Further indicative of the versatility and economy of resistance

welding is the tube mill, of which a typical example is shown below. A combination form-rolling and welding machine, it forms tubing and pipe continuously from strip, welds and trims the seam and cuts the tubing into required lengths, all on automatic cycle.

The resistance welder may also be applied to work entirely outside of welding; such, for example, as electro-working, in which a rod is heated between clamp-electrodes and then pulled apart to form such items as rake teeth and other pointed parts; electro-upsetting, analogous to forging, in which bar stock is heated as described above and then pushed together to form bulbous shapes and flanges; and electro-riveting, in



This tube mill welds, scarfs, sizes, straightens and cuts to length steel tubing at a rate of 15,000 to 45,000 ft per day. Tubing is formed in one continuous length in 7 steps.

Comparative manufacturing process data for spot and projection welding, shown respectively in left (carbon steel only) and right tabulations. Letter symbols designate elements as follows: T, thickness of each workpiece; W/T, weld time, cycles (60 per second); F, net electrode force in lbs.; A, approximate welding current at electrodes in amperes (60 cycles a-c); C, S, designates low carbon steel and S, stainless steel (projection welding only). Note that while the electrode force—F—and welding current for low-carbon and stainless vary, weld time is the same for both.

SPOT WELDING			
T In.	W/T	F	A
0.010	4	200	4,000
0.021	6	300	6,100
0.031	8	400	8,000
0.040	10	500	9,200
0.050	12	650	10,300
0.062	14	800	11,600
0.078	21	1100	13,300
0.094	25	1300	14,700
0.109	29	1600	16,100
0.125	30	1800	17,500

PROJECTION WELDING					
T	F		W/T	A	
	C	S		C	S
0.014	175	300	7	5,000	4,500
0.021	300	500	10	6,000	4,750
0.031	400	700	15	7,000	5,750
0.044	400	700	20	7,000	6,000
0.062	700	1200	25	9,500	7,500
0.078	1200	1900	30	13,000	10,000
0.094	1200	1900	30	14,500	10,000
0.109	1700	2800	30	16,000	13,000
0.125	1700	2800	30	17,000	14,000

which the rivets are coincidentally heated and headed.

In a related sense may be mentioned electro-brazing, in which lapped or scarfed parts are joined with brazing foil or spelter under pressure of the electrodes—which, in this case, imply carbon blocks. And electro-forging, used in fabrication of heavy screen and grills. However, both of these applications come under the head of welding; as for the others, they might also be done with induction heat.

Resistance welding plays an important role in the automotive and allied industries, where it effects economies out of all proportion to

capital investment. Here, applications can be on a colossal scale; on the other extreme is the butt-welding of copper rod in wire mills, prior to drawing. The welders used for this purpose are small enough to be held in the palm of the hand.

Included in the gamut of applications is the manufacture of toys, metallic furniture and household appliances, pails and buckets, electrical appliances and so on *ad infinitum*. And while space limitations preclude inclusion of more than a few of the many types of resistance welders, and their applications, this report nevertheless embraces standard practices and applications.

Bibliography:

"Recommended Practice for Resistance Welding," American Welding Society.

"Resistance Welding," by Wallace A. Stanley; published by the McGraw-Hill Book Company, Inc.

Tool Engineers Handbook, copyright 1949, American Society of Tool Engineers; published by McGraw-Hill Book Co., Inc.

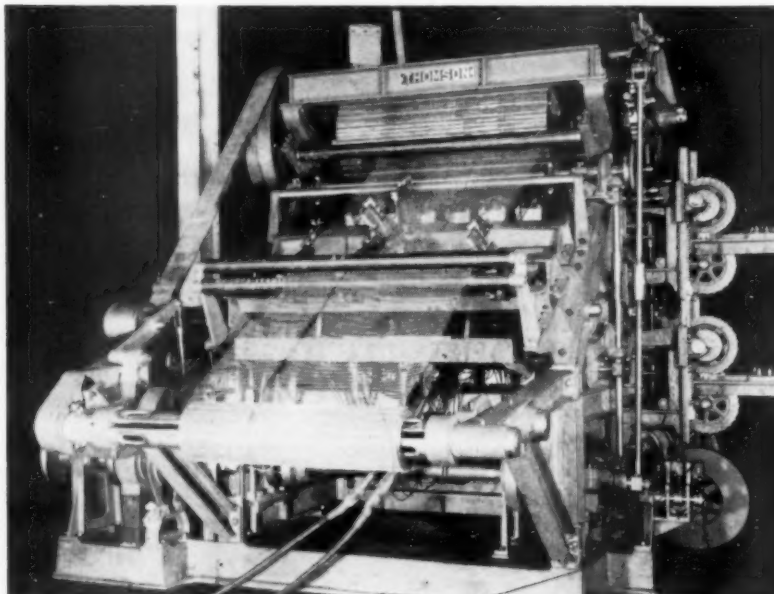
Credits:

The Midland Steel Products Company
General Electric Company
The Martin Electric Company
Thomson Electric Welder Company
American Electric Fusion Corporation

Cover:

This month's cover shows welding technicians at Alcoa's New Kensington, Pa., works tack welding an aluminum floor panel prior to roller spot welding.

Another Tool Engineering Report will appear in May issue, *The Tool Engineer*.



A black and white photograph of the Statue of Liberty, showing the statue from the waist up, holding the torch in her right hand and the tablet in her left. The statue is set against a clear sky.

19th
Annual Meeting
A.S.T.E.

New York
March 14-17, 1951

Our defense is in the
spirit which prized liberty
as the heritage of all
men, in all lands every-
where. Destroy this
spirit and you have
planted the seeds of
despotism at your own
doors. *A. Lincoln*



From the Battery to the Bronx

By Doris B. Pratt

NEW YORK Is an Engineer's Town

Tool Engineers Will Stream in to Mobilize Technical How-To for Defense Speakers to Reveal New Highs in Machining Speeds, Precision Production

PERHAPS YOU'VE always thought of New York as self-sufficient in its high strung, money mad rush. New Yorkers seem to think so, too. But without engineering their town would literally fall apart, their frantic hurrying slow to a turtle's pace.

Towering skyscrapers would lurch and plunge to the street. High-speed traffic tubes and tunnels would collapse with the weight of tons of water. Bridges that lace Manhattan to surrounding boroughs would twist and sag. Express elevators would fall, or leap uncontrolled through roof housings. Subways would cave in like trampled mole runs. Even the gallant lady carrying the torch for Liberty would keel over in the brutal, harbor winds.

Behind each of the city's engineering masterpieces were tools. Dies to draw the 26,474 wires of 0.196 in. diameter that make up yard-thick cables supporting the George Washington Bridge. Precision equipment to test the wire to 225,000 lb psi. Presses to form the more than 150,000 tons of structural steel in its span and towers. Look it over from a tooling standpoint while you're in town for the Society's annual meeting, March 14-17.

For 60 years a small monument has been reminding New York of its dependence on the metal working industry. It was during another convention there that the three great steel associations of America, England and Germany joined with international engi-

neering societies to honor Alexander Lyman Holley.

The memorial erected to him in Washington Square Park by "engineers of two hemispheres" cites him as "foremost among those whose genius and energy established in America and improved throughout the world the manufacture of Bessemer steel."

As a result of Holley's original improvements in design whereby large-scale production of steel was accomplished, metal working in and around New York has become an important industry. It serves clothing, food processing, publishing, construction, aircraft, shipbuilding and other manufacturing activities in the metropolitan New York-New Jersey district.

Men from area plants predominate among 37 speakers participating in the 24 technical sessions on the ASTE program. Their papers include five on new developments in pressworking of metals, eight concerning machining, six about inspection and quality control methods, and eight on tooling, in addition to six on general and highly specialized subjects.

New Figures on Carbide Cutting

These manuscripts indicate revelations on new concepts in practical machinability measurement, as well as ways of achieving machine speeds far in excess of average current practice. For example, with carbide tooling, a .020 in. chip load has been successfully taken on SAE 1030 steel, running at 1435 sfm, with cutter and tool still at room temperature at end of run.

Using a high-rake-angle, staggered-tooth cutter of super-high-speed steel, C-1113 steel has been milled at the rate of 350 sfm, 20 ipm feed, with 0.009 in. chip load per tooth.

A two-man symposium on machine tool mounting for vibration dampening will make significant contributions to improvement in forming and machining metals and extension of machine tool and tool life through eliminating injurious vibrations.

Report Tests on Tapping Torques

Members will acquire a broad viewpoint on inspection and testing. They will hear reports of modern findings on strain gaging and brittle coating for stress tests. Along the same vein are discussions of a wide range of programs for continuous and automatic gaging; also methods of employing optical projection as a tool in quality control.

One manufacturer considered his presentation before the Society important enough to run a series of special tests to determine torques developed in tapping. All factors entering the problem have been considered in these tests.

Most of the speakers will augment their lectures with slides, films, charts, samples or other demonstration material.

Papers Available at Nominal Cost

To aid listeners in following the lecturers, preprints of their papers will be distributed. The entire collection of papers, plus the written discussions, may be ordered at \$2.50 per set. Single papers are 50c per copy.

As each talk is concluded, two experts in the specific field will read their prepared comments on the paper. Any points remaining in doubt may be cleared up by questions from the floor during the oral discussion period. Thus each subject will be thoroughly covered to the extent of the audience's particular requirements.

In initiating the presentation of written opinions by authorities, the Society aims at national meetings of a scope and pattern already proven effective in other leading professional societies.

BACK IN CIVIL WAR days Alexander Holley wrote a military treatise on ordnance and armour. Today's tool engineers will sit down with ordnance officers for a frank exchange of information on the production of defense materiel. Wednesday evening Lt. Gen. K. B. Wolfe, deputy chief of staff for materiel, U. S. Air Force Headquarters, Washington, D. C. will lead a Mobilization Technical Know-How Conference with an address, "Military Importance of Tool Engineering."

After General Wolfe's talk the forum will be open for questions from both sides of the rostrum. Assisting the general will be Colonel John S. Walker,



During an international convention of steel associations in 1890, "engineers of two hemispheres" erected this monument to Alexander Lyman Holley, the father of modern American steel production. Today thousands pass this memorial to the foremost U. S. steel plant engineer and designer of his time unaware of its significance.

deputy district chief, New York Ordnance District, and Captain Carlyle L. Helber, Bureau of Aeronautics general representative, Eastern District, New York Naval Shipyard.

As chief of the production division of the Air Materiel Command, General Wolfe was responsible for the initiation and operation of the U. S. Air Force World War II aircraft program. Colonel Walker's assignments have taken

him to arsenals and ordnance works around the country. Broadly experienced in aeronautical engineering, Captain Helber has made significant contributions to an international standardization program and in the development of the Air Documents program. These engineers represent the air, land, and sea arms of the military service.

Moderator for the forum is Roger F. Waindle, ASTE third vice-president. President Herbert L. Tigges and Second Vice-President Harold E. Collins, complete the Society's official representation on the platform. All are experienced in ordnance production from manufacturing or procurement standpoints.

To See Tooling on the Job

But there's still more technical meat. Eight companies in the vicinity are opening their plants to the Society. Their ideas on tooling may be just what you need in your own applications. Intricate machinery, extreme accuracy, and high production characterize the activities of these factories.

An officer of one of these companies will give the banquet address Friday evening. Richard F. V. Stanton, executive vice-president and general manager of American Machine & Foundry Co., Brooklyn, will discuss the tasks the tool engineering profession faces to protect the American economy for defense and peace.

Is Former Ordnance Chief

An ASTE'er, Mr. Stanton is a lieutenant-colonel in the Army Ordnance Reserve, was formerly chief of the Ordnance Small Arms Division at Hartford. He chairmanned a war tooling session at the Society's War Production Conference Semi-Annual Meeting at Springfield, Mass., in 1942.

For the benefit of early arrivals and official representatives attending Wednesday meetings of the board of directors and house of delegates, the registration desk will be open Tuesday evening on the second floor foyer of the New Yorker. Registration will continue all day Wednesday and throughout the convention. Everyone is urged to register upon arrival to prevent pre-session jams that may delay the opening of technical meetings.

Bring Membership Card

Presentation of a current membership card will facilitate registration. Non-members should be prepared to show their identification with industry.

Accompanied by instructors, groups of students from local engineering schools will be admitted to technical sessions, according to plans of the chapter Membership Committee.

Following a practice inaugurated at the Philadelphia exposition last spring,

a copy of this convention issue of *The Tool Engineer* will be given to each registrant as the official program.

Technical sessions will be held on the second, third, and fourth floors of the New Yorker at 9:30 a.m., 2:30 and 8:00 p.m. Plant tour buses will leave the 34th Street entrance of the hotel promptly at 9:00 a.m. The banquet will be served at 7:00 p.m. in the Grand Ballroom, preceded by a brief reception in the ballroom lounge.



Everything has been arranged to save time and effort for the visitor. Transportation lines fan out from the New Yorker. It is close to the new Port Authority Bus Terminal, a convenience for commuting members from surrounding towns.

Banquet tickets will be sold at the registration desk. Regular Society services also will be available. Handbooks may be ordered, dues paid, membership emblems purchased, membership applications filed, and address changes recorded. Headquarters personnel will be on hand to discuss matters of especial interest to individual members.

Headed by Harmon S. Hunt, a past chairman of Greater New York chapter, the host chapter committee will handle registrations for plant tours and ladies events, and physical arrangements for other activities.

Executive Secretary Harry E. Conrad is convention manager. John S. Eacock, his assistant, will be in charge of registration. Frank W. Wilson, national program secretary, will coordinate technical activities. In his capacity as book editor, Mr. Wilson will welcome contributions from members for the new

die design manual the Book Committee is compiling.

See the Sights Over the Weekend

With the meeting closing Saturday noon, most members can stay over a day to see the town and still get back to business Monday morning.

There's plenty to do and see in this city that was the country's first capital and is now headquarters of the United Nations. Starting downtown in the Wall Street section there's the Sub-Treasury Building on the site of Federal Hall where Washington took his oath of office as the first president. You can identify it by the statue of him at the entrance.

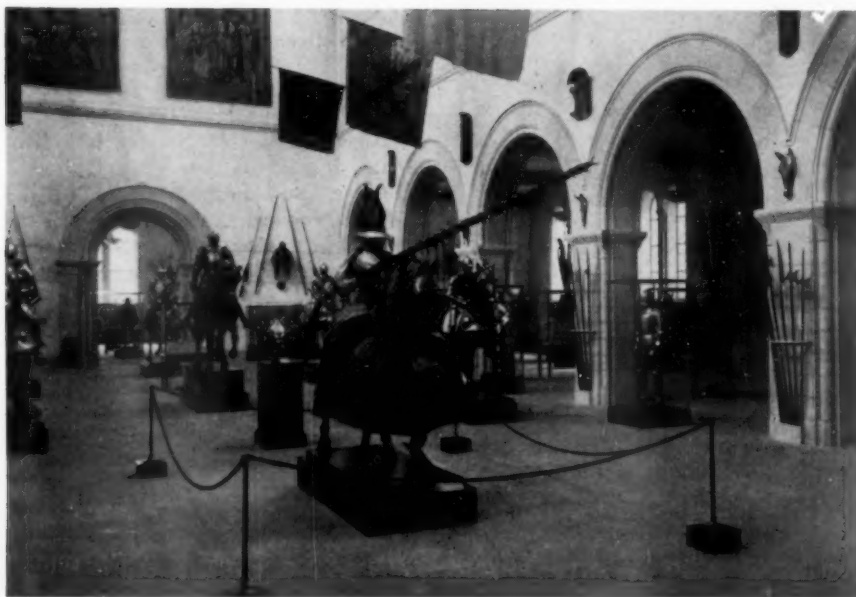
In the graveyard of Trinity Church, founded by Royal Charter in 1697, Alexander Hamilton and other noted Americans sleep. The New York Stock Exchange has a visitors gallery open weekdays and Saturday mornings. It was founded during Washington's administration, to pay for the Revolution, only a few blocks from its present location.

Fraunces Tavern, the scene of General Washington's farewell to his officers, is a public shrine. You can have lunch there, too.

Village Has Arty Atmosphere

Below Washington Square Arch, Greenwich Village is a quiet backwater inhabited by artists and writers. Its quaint streets, curio shops and picturesque outdoor art shows have strong tourist appeal.

For a night on the town there's Broadway and the mid-town entertainment district. If culture's your dish,



From top: The Peters, Ted and Dennie, are one of the talented teams of entertainers who will perform at the ASTE banquet. The medieval metal worker's art is preserved in this collection of armour at the Metropolitan Museum of Art. A democratic organization, the Union Twist Drill Employees' Glee Club is a cross-section of the company from sweeper to executive. Led by Director Ernest J. Hills, the Athol, Mass. singers will give a concert at the Society's annual dinner.





take in Carnegie Hall, the Metropolitan Opera House or the city's museums. A popular trysting place, the Cloisters branch of the Metropolitan Museum of Art, at Fort Tryon Park has an interesting collection of medieval art. Sports fans will make a beeline for Madison Square Garden.

Columbus Circle commemorates the discoverer of this country. Nearby on Central Park West is a monument to the heroes of the battleship Maine.

Along the East River the new United Nations Building looms like a tall, glass-sided wafer.

Many high points of interest will be included in the program for the ladies. They'll take a bus through Long Island to the United Nations Assembly at Lake Success, with the privilege of lunching at the U.N. cafeteria.

A sightseeing tour will lead through residential, educational and cultural centers in uptown New York, and Harlem.

Two big department stores will take the women behind the scenes, show them how merchandise is handled before and after it is sold, how it is tested for quality and performance. The visitors will see personnel training and service departments, a candy factory, a fashion photo studio. A fine specialty shop will put on a fashion show brunch.

Evenings there will be trips to Hayden Planetarium, radio and TV studios, and shopping expeditions.

Nothing has been overlooked to give everybody a pleasant and profitable time. The detailed program of events follows on subsequent pages.

Right, center: The statue of Washington in front of the Sub-Treasury Building marks the site where the first president took his oath of office when New York was the nation's capital. Below: ASTE ladies attending the convention will see the Easter heavens projected on the dome at Hayden Planetarium.

Left: This marble figure flanking the New York Customs House entrance is one of 12 representing seafaring powers that have contributed to world commerce. **Center:** In the Governor's Room at City Hall you can see the desks of the first three presidents of the United States. **Right:** Visitors to an open air art show in Greenwich Village watch an itinerant painter and his dusky subject.

American Society of Tool Engineers
10700 Puritan Ave.
Detroit 21, Mich.

Please send me a full set of 19th Annual Meeting papers and discussors' comments as soon as they are available.

Attached is check for \$2.50 to cover cost of preparation and mailing.

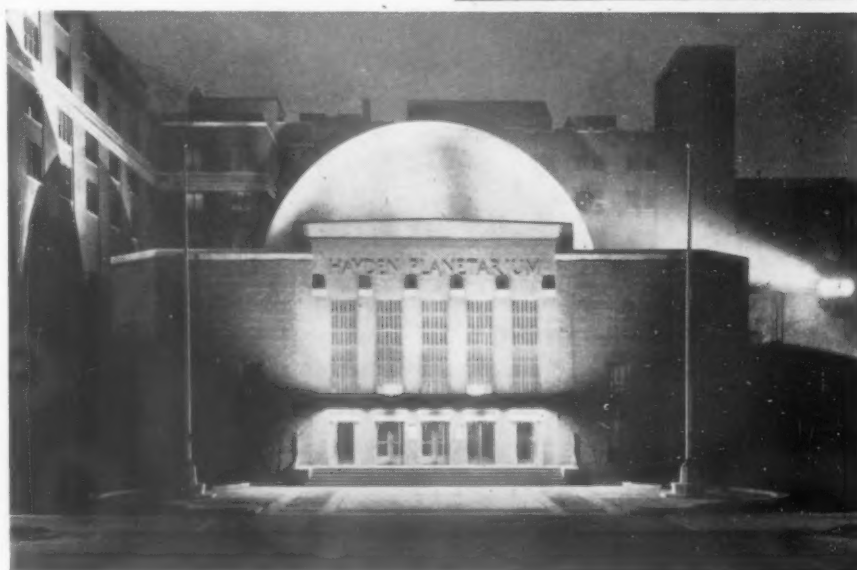
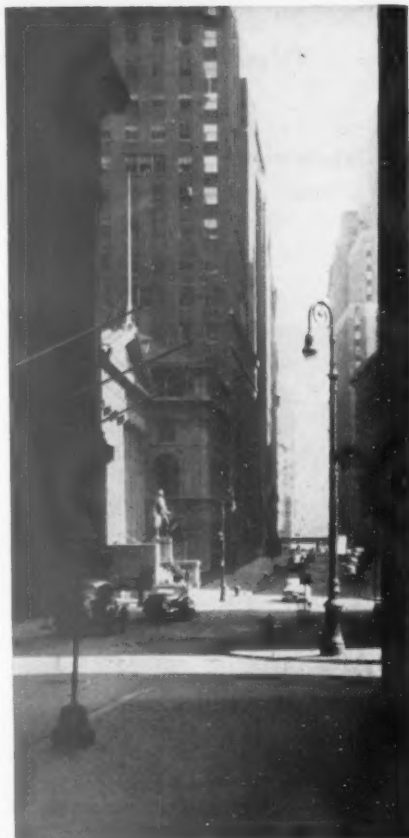
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Program

19th Annual Meeting

American Society of Tool Engineers

Hotel New Yorker, New York City

March 14-17, 1951

Wednesday, March 14

8:30 A.M.

Registration Opens, Second Floor Foyer

(Advance registration, 8:00 p.m. Tuesday)

Speakers



Col. J. S. Walker



Capt. C. L. Helber



Lt. Gen. K. B. Wolfe



Thomas Badger



S. D. Broetzkoos



F. W. Curtis



A. D. F. Moncrieff



F. G. Tatnall



Greer Ellis



Harry Pelphrey



I. W. Hutchison, Jr.



H. E. VanValkenburg



G. A. Richroath



M. D. Verson



F. W. Boulger

Wednesday, March 14

9:30 A.M.

Board of Directors Meeting, East Room, Fourth Floor

House of Delegates Caucus and Meeting, Parlors F and G, Fourth Floor

8:00 P.M.

Mobilization Technical Know-How Conference, Grand Ballroom

Moderator, Roger F. Waindle, ASTE Third Vice-President

Military Importance of Tool Engineering, an address by Lieutenant General Kenneth B. Wolfe, Deputy Chief of Staff for Materiel, U. S. Air Force Headquarters, Washington, D. C.

Panel Members: Colonel John S. Walker, Deputy District Chief, New York Army Ordnance District; Captain Carlyle L. Helber, Bureau of Aeronautics General Representative, Eastern District, New York Naval Shipyard; Herbert L. Tigges, ASTE President, and Harold E. Collins, ASTE Second Vice-President

Thursday, March 15

9:00 A.M.

Plant Tours—American Machine & Foundry Co., Brooklyn; Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.; Propeller Div., Curtiss-Wright Corp., Caldwell, N. J., and Ford Motor Co., Edgewater, N. J.

Thursday, March 15

9:30 A.M.

Technical Session, Grand Ballroom, Second Floor

Chairman, Edward F. Calvin, President, Calvin Tool Sales Corp., New York

Machinability Measurement on Constant-Pressure Lathes, Francis W. Boulger, Supervising Metallurgist, Battelle Memorial Institute, Columbus, Ohio

Technical Session, North Ballroom, Second Floor

Chairman, John L. Webster, Master Mechanic, Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.

Hobs and Hobbing in High Production, Don A. Moncrieff, Assistant Chief Engineer, and Harry Pelphrey, Research Engineer, Michigan Tool Co., Detroit, Mich.

Technical Session, Parlors F and G, Fourth Floor

Chairman, Walter A. Stadler, Manager, Technical Research Dept., International Business Machines Corp., Poughkeepsie, N. Y.

What the Tool Engineer Should Know About Silicones, Ira W. Hutchison, Jr., Sales Development Engineer, Dow Corning Corp., New York

Technical Session, Panel Room, Third Floor

Chairman, William Schoen, Chief Engineer, Columbia Metal Box Co., Bronx, N. Y.

Optimum Use of Mechanical Presses, Sergius D. Brootzkoo, Mechanical Engineer, General Services Administration, Washington, D. C.

2:30 P.M.

Technical Session, Grand Ballroom, Second Floor

Chairman, Eugene Roth, President, Eugene Roth, Inc., New York

Production Evaluation of Cutting Tool Materials, Thomas Badger, Headquarters Manufacturing Engineering Dept., Westinghouse Electric Corp., Pittsburgh, Pa.

Technical Session, Panel Room, Third Floor

Chairman, H. E. Linsley, Associate Editor, *American Machinist*, New York

Inert-Gas-Shielded Arc Welding as a Manufacturing Method, H. O. Jones, Welding Specialist, Air Reduction Sales Co., New York

Technical Session, North Ballroom, Second Floor

Chairman, Adolph Moses, Designing Engineer, Morey Machinery Co., Inc., Astoria, L. I., N. Y.

Non-Destructive Testing and Inspection

Applications of Bonded Wire Strain Gages, Francis G. Tatnall, Manager of Testing Research, Baldwin Locomotive Works, Philadelphia, Pa.

Brittle Coatings for Stress Analysis Greer Ellis, Consulting Engineer, Magnaflux Corp., New York

Ultrasonic Inspection Today, H. E. VanValkenburg, Engineering Dept., Sperry Products, Inc., Danbury, Conn.

Technical Session, Parlors F and G, Fourth Floor

Chairman, Horace N. Walden, Tool Engineer, American Machine & Foundry Co., Brooklyn, N. Y.

Production Plunge Grinding, Frank W. Curtis, Chief Engineer, Machine Tool Div., The Van Norman Co., Springfield, Mass.

Technical Session, East Room, Fourth Floor

Chairman, Ellis Thorp, President, Falkill Machine Co., Inc., Poughkeepsie, N. Y.

Lubricant Practice in the Forming of Metals, E. L. H. Bastian, Staff Engineer, Shell Oil Co., New York

Speakers



W. P. Coomey



W. R. Frazer



Arnold Pfenninger, Jr.



H. O. Jones



Dan Verson



Earle Buckingham



R. A. Winblad



B. H. Marks



H. S. Ingham



E. C. Polidor



G. J. Scranton



E. L. H. Bastian

Thursday, March 15

8:00 P.M.

Technical Session, Grand Ballroom, Second Floor

Chairman, C. W. Johnson, Factory Manager, American Machine & Foundry Co., Brooklyn, N. Y.

Raising the Limits on Machining Speeds

Raising the Limits on High-Speed-Steel Machining, W. R. Frazer, Chief Metallurgist, Union Twist Drill Co.

Raising the Limits on Carbide Machining, William P. Coomey, General Superintendent, Rice Barton Corp., Worcester, Mass.

Technical Session, North Ballroom, Second Floor

Chairman, Edward R. Murphy, Assistant to Plant Manager, American Can Co., Newark, N. J.

Inspection by Optical Projection Methods, Edward C. Polidor, Chief Engineer, Engineering Specialties Div., Universal Engraving & Colorplate Co., Rochester, N. Y.

Technical Session, Parlors F and G, Fourth Floor

Chairman, Arthur N. Kugler, Mechanical Engineer, Air Reduction Sales Co., New York

Tooling Up for Metallizing, H. S. Ingham, Chief Engineer, Metallizing Engineering Co., Long Island City, N. Y.

Technical Session, Panel Room, Third Floor

Chairman, Arthur F. Murray, Works Manager, Electrolux Corp., Old Greenwich, Conn.

Plant Layout for Precision Manufacturing, George A. Richroth, Manufacturing Engineer, Sperry Gyroscope Co., Great Neck, L. I., N. Y.



A. J. Carruthers



A. Melnick



R. F. V. Stanton



Charles Aldino



Adolph Bregman



E. M. Hicks



H. M. Goldman



John Macewka



A. C. Sanford

Friday, March 16

9:00 A.M.

Plant Tours—DeJur Amsco Corp., Long Island City, N. Y.; Allen B. Du Mont Laboratories, E. Paterson, N. J.; Mergenthaler Linotype Co., Brooklyn, N. Y., and Wright Aeronautical Corp., Wood-Ridge, N. J.

9:30 A.M.

Technical Session, Grand Ballroom, Second Floor

Chairman, Charles O. Herb, Editor, *Machinery*, New York

Criteria for Selecting Production Milling Methods, Robert A. Winblad, Head of Milling Estimating Div., Cincinnati Milling Machine Co., Cincinnati, Ohio

Technical Session, North Ballroom, Second Floor

Chairman, W. E. Wheaton, Production Planner, Walter Scott & Co., Inc., Plainfield, N. J.

Administration of Quality Control, George J. Scranton, Manager, Standards and Methods Dept., Quality Control Manufacturing Staff, Ford Motor Co., Dearborn, Mich.

Technical Session, Parlors F and G, Fourth Floor

Chairman, Marvin C. Barnum, Sales Engineer, Dayton Rogers Manufacturing Co., New York

Non-Concentric Automatic Transfer Pressworking, Melvin D. Verson and Dan Verson, Engineers, and E. J. O'Connell, Verson Allsteel Press Co., Chicago, Ill.

Technical Session, Panel Room, Third Floor

Chairman, Julian Wille, President, Julian Wille Associates, New York

Manufacturing Applications of Liquid Impact Blasting, B. H. Marks, Manager of Hydro-Finish Div., and A. L. Gardner, Pangborn Corp., Hagerstown, Md.

Technical Session, East Room, Fourth Floor

Chairman, Llewellyn H. Tenney, Product Engineer, The DeLaval Separator Co., Poughkeepsie, N. Y.

What Do You Need from Gears? Earle Buckingham, Professor, School of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

Speakers



W. P. Powers



J. M. Delfs



W. A. Papworth

Friday, March 16

2:00 P.M.

Judicial/Honor Awards Committee Meeting, Parlor A

2:30 P.M.

Technical Session, Grand Ballroom, Second Floor

Chairman, W. Cortlyn Rhodes, Jr., President, Airborne Accessories Corp., Hillside, N. J.

Machine Tool Mountings for Vibration Dampening

Steel Spring-Type Mountings, Donald A. Vance, Assistant General Manager, The Korfund Co., Long Island City

Reduction of Vibration, Sound and Shock Transmission With Rubber Mounts, Arnold P. Pfenninger, Jr., Chief Engineer, The Connecticut Hard Rubber Co., New Haven, Conn.

Technical Session, North Ballroom, Second Floor

Chairman, Thomas P. Orchard, Sales Promotion Manager, Airborne Accessories Corp., Hillside, N. J.

Automatic Control of Machine Tools, J. M. Delfs, Apparatus Dept., General Electric Co., Schenectady, N. Y.

Technical Session, Parlors F and G, Fourth Floor

Chairman, Joseph L. Petz, President, J. L. Petz Co., Poughkeepsie, N. Y.

Tumble Finishing

Techniques of Abrasive Tumbling, Hubert M. Goldman, Chemical Engineer, Enthone, Inc., New Haven, Conn.

Economic Possibilities in Tumble Finishing, Adolf Bregman, Consulting Engineer, New York

Technical Session, Panel Room, Third Floor

Chairman, A. J. Schmidt, President, Schmidt Permanent Mold Corp., Newark, N. J.

Tooling for Multiple-Slide Presses, W. P. Powers, Secretary, and A. Melnick, Chief Tool Engineer, U. S. Tool Co., Ampere, N. J.

Technical Session, East Room, Fourth Floor

Chairman, Charles B. Carlson, Works Counsel, Thomas A. Edison, Inc., W. Orange, N. J.

Economics of Machine Replacement, E. M. Hicks, Assistant Manager, Grinding Machine Div., Norton Co., Worcester.

Technical Chairmen



William Jarvis



A. F. Murray



C. O. Herb



Adolph Moses



W. C. Rhodes



Julian Wille

6:30 P.M.

Banquet Reception, Ballroom Lounge, Second Floor

7:00 P.M.

Annual Banquet and Membership Meeting, Grand Ballroom, Second Floor

Annual Report to Membership, President Herbert L. Tigges

Tool Engineering—America's Strength, an address by Richard F. V. Stanton, Executive Vice-President and General Manager, American Machine & Foundry Co. A lieutenant-colonel in the Army Ordnance Reserve, Mr. Stanton was formerly chief of the Army Ordnance Small Arms Division at Hartford, Conn. He is a member of the Hartford ASTE chapter.

Installation of National Officers

Presentations

Entertainment

Concert by Union Twist Drill Employees' Glee Club of Athol, Mass.

Dancing



J. L. Webster



T. P. Orchard



Ellis Thorp



E. R. Murphy



H. N. Walden



Joseph L. Petz



Edmond Morancey



H. D. Hall



William Schoen



G. H. Grossnickle



L. H. Tenney



A. N. Kugler



W. A. Stadtler



C. B. Carlson



C. W. Johnson



J. B. Gosselin



Eugene Roth



W. E. Wheaton

Saturday, March 17

9:30 A. M.

Technical Session, Grand Ballroom, Second Floor
Chairman, H. D. Hall, H. D. Hall Foundation, Newark, N. J.

Multi-Cylinder Hydraulic Presses and Controls, John Macewka, President, Wolverine Hydraulics Co., Royal Oak, Mich.

Technical Session, North Ballroom, Second Floor
Chairman, William Jarvis, Charles L. Jarvis Co., Middletown, Conn.

Measuring and Interpreting the Factors in Tapping Torques, A. J. Carruthers, Research Engineer, Greenfield Tap & Die Corp., Greenfield, Mass.

Technical Session, Parlors F and G, Fourth Floor
Chairman, J. B. Gosselin, Gage Engineer, Bulova Watch Co., Woodside, N. Y.

Continuous and Automatic Gaging, A. C. Sanford, Sales Engineer, Federal Products Corp., Providence, R. I.

Technical Session, Panel Room, Third Floor
Chairman, Grayson Grossnickle, Division Manager, Westinghouse Electric Corp., Newark, N. J.

Manufacture of Fine-Pitch Gears, Charles Aldino, Processing Engineer, Sperry Gyroscope Co., Great Neck, L. I., N. Y.

Technical Session, East Room, Fourth Floor
Chairman, Edmond Morancey, Sales Manager, United Tool and Die Co., W. Hartford, Conn.

High-Production Abrasive Belt Finishing, W. A. Papworth, Staff Engineer, Porter-Cable Machine Co., Syracuse, N. Y.

A. J. Schmidt

E. F. Galvin

H. E. Linsley

M. C. Barnum

Technical Chairmen

Ladies Program

Wednesday, March 14

7:00-9:00 P. M.—Radio and TV Studio Shows

Thursday, March 15

11:00 A. M.—**United Nations Tour**—Bus leaves Hotel Astor, 44th and Broadway. Trip to Lake Success, admission to General Assembly. Luncheon (optional) at U. N. cafeteria.

12:00 Noon—**Seeing New York from Empire State Building** Observatories at 86th and 102nd floors. Tearoom at 86th.

2:00 P. M.—**Sightseeing Bus Tour**—Uptown New York and Harlem. Residential, educational, cultural centers. Stops include Frick Museum, Cathedral of St. John the Divine, Columbia University, Grant's Tomb on the Hudson.

4:00 P. M.—**NBC Tour**. News room, network control center, sound effects, studios. Visitors will be televised.

5:00 P. M.—**Rockefeller Center**—Guided tour includes buildings, Music Hall, roof gardens, skating rink, underground shops, observation roofs.

7:00 P. M.—**Hayden Planetarium**—Sky Show, Easter in the Heavens. Radio and TV Studio Shows. Evening Shopping.

Friday, March 16

10:00 A. M.—**Fashion Show Brunch** at Altman's Charleston Gardens.

2:00 P. M.—**Behind the Scenes at Macy's**—Handling of merchandise, employee services, telephone order board, bureau of standards for testing merchandise, training classrooms, customer bank.

3:00 P. M.—**Behind the Scenes at Gimbel's**—Candy factory, display, advertising, delivery, training departments, fashion photo studio.

4:00 P. M.—**Museum of Modern Art**—All phases of contemporary art and design. Current exhibition: Abstract Painting and Sculpture in America.

7:00 P. M.—**ASTE Annual Banquet**.

Saturday, March 17

11:00 A. M.—**Ferry Trip to Statue of Liberty** on Bedloe's Island. View of harbor from observation balcony.

2:00 P. M.—**St. Patrick's Day Parade** along Fifth Avenue, followed by Easter window shopping.

7:00 P. M.—**Radio and TV Studio Shows**.

9:00 P. M.—**Greenwich Village Tour**—Interesting art and craft shops, restaurants, night spots.

Please sign up at registration desk for these events.



National Officers



H. L. Tigges
President



J. J. Demuth
First Vice-President



H. E. Collins
Second Vice-President



R. F. Waindle
Third Vice-President



W. B. McClellan
Secretary



G. A. Goodwin
Treasurer



W. A. Thomas
Asst. Secy.-Treas.



H. E. Conrad
Executive Secretary



W. H. Lentz
Social Programs



H. L. Horton
Technical Activities



G. A. Rogers
National Program Chairman



H. S. Hunt
General Chairman



Julius Schoen
Supplementary Functions

Host Chapter Chairmen



Idalyn Cohen
Publicity



James Fitzpatrick
Technical Sessions



E. F. Galvin
Housing



J. P. Schneider
Plant Tours



G. H. DeGroat
Reception



Virginia Martino
Ladies Activities



H. E. Linsley
N. New Jersey Chapter
Coordinator, Sessions



Murray Ehrenhaus
Registration



M. H. Lipton
Sessions Arrangements



Carl Kertesz
Banquet



H. S. Freiman
Entertainment



A. J. Schmidt
N. New Jersey Chapter
Coordinator, Plant Tours



John Dokulil
Budget



M. M. Tanenbaum
Transportation



Arthur Smedley
Records and Reports



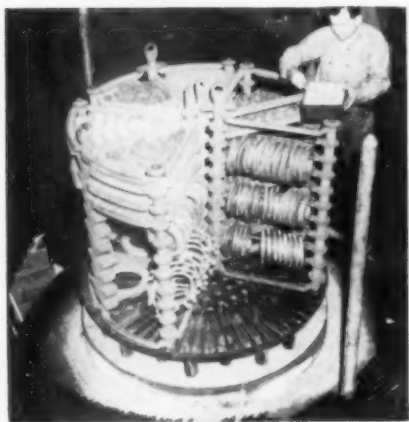
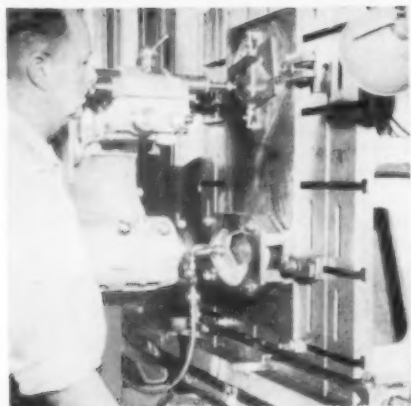
E. N. Eckler, Sr.
Signs



J. K. Wohlfeld
Tickets



S. J. Wotzak
Emergencies



Know-How of Firms That Pioneered Industries Wins

DO Rating



For Convention Plant Tours
In New York-New Jersey

MEN WITH IDEAS ahead of their times founded them. Other men, just as persistent in working out advanced ideas, are keeping these companies in the industrial limelight. Their plants are the ones tool engineers will visit during the Society's New York meeting.

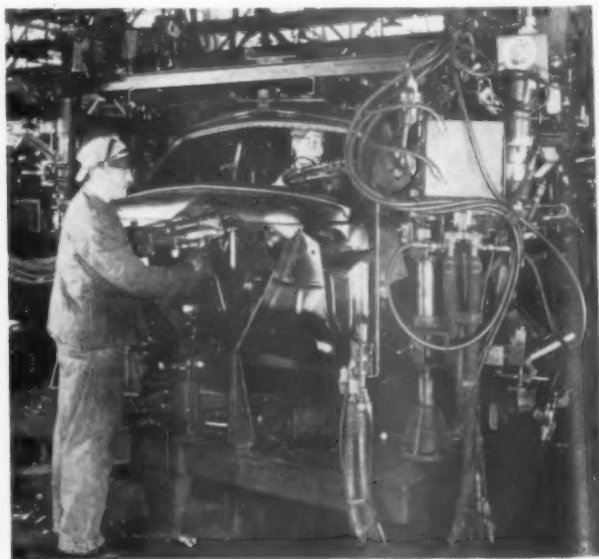
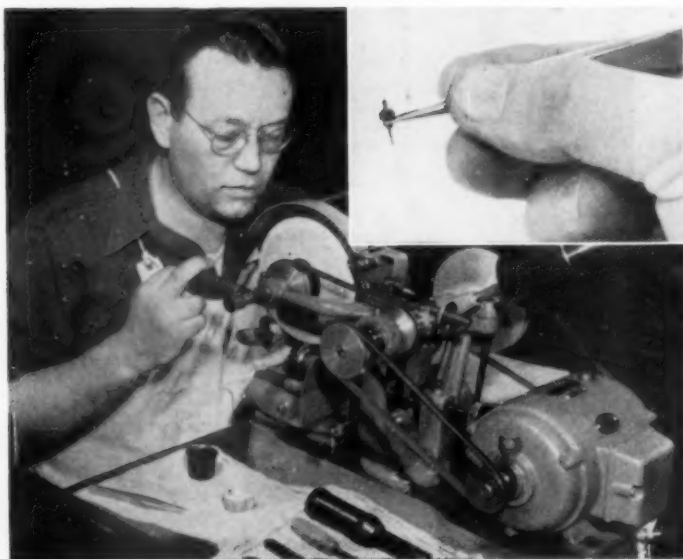
Between flimsy contraptions, used by the Wright brothers and Glenn Curtiss in their early experimental flights, and today's sky ships of stronger-than-steel metals is the story of Curtiss-Wright

Corp. Workers at C-W must be perfectionists since failure of materials processing or moving parts in aircraft can be costly in human life.

At the Caldwell, N. J. plant you can see unusual welding and shaping operations in the fabrication of the largest production aircraft propeller. One operation is unique. Heated orange-red hot, the welded steel plate blade is held between large forming dies while nitrogen gas, applied under 1100 lb psi, inflates it to the curved shape and twist of the die cavity.

Production continues with finishing

From top: An employee at DeJur-Amsco Corp. demonstrates dynamic balancing of armatures and blower fans used in motion picture projectors, to assure quiet and vibration-free operation. A binder die shell for a cigar machine is profile milled in two dimensions at American Machine & Foundry Co. Hundreds of steel parts make up a "charge" in a heat treat furnace at Wright Aeronautical Corp. This machine polishes each of 52-gear-tooth faces on a tiny pinion gear (inset) used in the Eclipse-Pioneer airspeed indicator. Below: Heavy jigs, called body bucks, clamp panels into place for welding in the body-in-white build-up at Ford Motor Co.'s Edgewater assembly plant.



and exhaustive inspection. Final balance of the blade is achieved by pouring lead into a small cup, sweated into the shank.

The same exactness prevails throughout the engine plant at Wood-Ridge. Here production lines transform rough castings into parts accurate to a tenth. Using delicate instruments, skilled personnel make more than 100,000 tests and inspections on a single engine. Every engine is tested, torn down, inspected, reassembled and tested again before it is approved for service.

Over 5000 Parts in Linotype

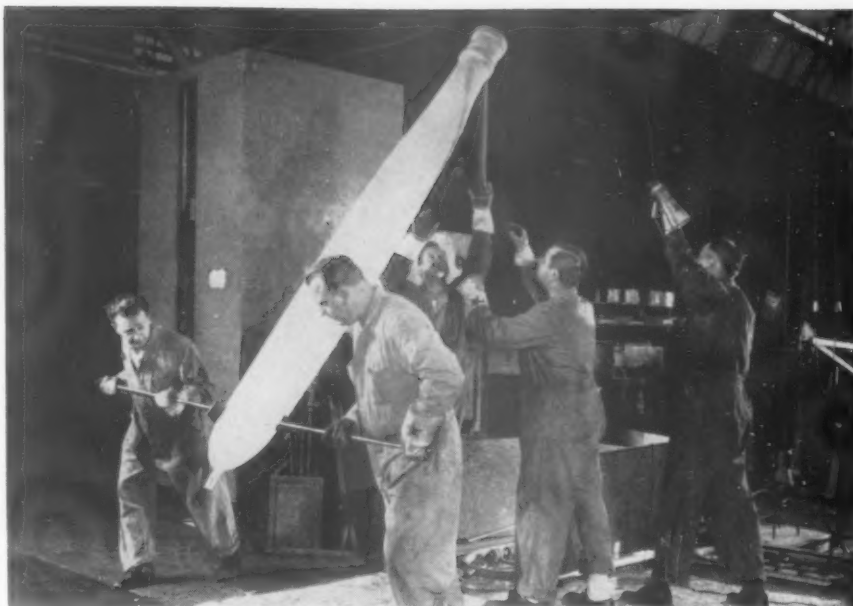
While Ottmar Mergenthaler didn't originate typesetting machines, he devoted his life to developing and producing the commercial linotype—an invention that has brought education to the masses. The Brooklyn company named for him will show you their collection of prototypes.

Chief process in making the more than 5000 parts of this precision, casting machine is milling, departmentalized by material. Attention will center around the climb milling, duplex milling, and carbide applications.

A tobacco trade journal once scoffed at an announcement that a commercial cigar making machine had been produced. But it was true. American Machine & Foundry Co. had licked the problem of feeding tobacco in millions of different sizes, shapes, textures and strengths into one end of a machine and delivering uniform cigars at the other.

If you visit their Brooklyn plant, you'll see it demonstrated. They'll explain the tooling, machining operations, and ingenious mechanical motions involved in this and machines that roll cigarettes, package them, tie knots in

Hundreds of parts are installed in TV sets along this assembly line at Allen B. Du Mont Laboratories.



A Curtiss-Wright hollow steel propeller blade is moved from an electric furnace preparatory to inflation in a blow-up die under 1100 lb psi pressure of nitrogen gas.

pretzels, slipstitch necktie linings, pick up bowling pins, return the ball and even "remember" the play.

Currently hailed as the outstanding contributor to advancement of the cathode-ray tube, Dr. Allen B. Du Mont founded his experimental laboratories in the basement of his home 20 years ago. Refinements and developments he worked out made commercial television practical.

Special Quality Control Work

In the huge Du Mont assembly plant at East Paterson, N. J., everything is on the move. Tubes, chassis, parts are all mechanically handled by automatic conveyors. Besides the assembly lines, special work by the quality control department will be pointed out, such as shake tables for vibration testing, humidity chambers and other specialized testing.

Offspring of the founder of the production line, the Ford Motor Co. assembly plant at Edgewater, N. J. loads one-third of its output directly into freighters at its own docks. Practically every unit exported is a "special job." Vehicles going to desert countries must have high fenders and special tires; cars earmarked for mountainous lands need special rear axles, transmissions and carburetors to allow for high altitudes.

Time to Split-Second

One of the final assembly operations impresses visitors with the high degree of synchronization maintained. Each completed body drops onto its chassis on a split-second schedule.

In practically every flight that has made aviation history, the work of the Eclipse-Pioneer Division of Bendix Aviation Corp. has figured. It turns out hundreds of different devices and instruments needed in modern aviation.

Extreme precision is demonstrated in such operations as the winding of gold plated tungsten wire about half the diameter of a human hair, to form the grid for a miniature vacuum tube.

Guides will take ASTE members through the tool design and tool manufacturing sections, machine shops and instrument assembly area. Highlights of this trip will include the mechanized, aluminum and magnesium foundries.

The cutting of spur and helical gears from nylon, micarta, aluminum, brass and steel will attract many to the DeJur-Amsco Corp. plant in Long Island City. Precision will be everywhere apparent in the production and inspection of parts for photographic equipment.

Cameras Adjusted by Stroboscope

The highly complex art of building cine cameras, printing enlargers, exposure and industrial meters include stroboscopic adjustment of film running speeds, construction of spring motors, fine balancing of meter pointers, assembling tiny parts with the aid of a microscope, exhaustive inspection tests with specially designed equipment, and more.

To participate in most of these tours you must show U. S. citizenship identification. Foreign nationals and American citizens employed by foreign governments must be cleared.



Bon Voyage

Bermuda-Bound Post-Convention Party Sails March 17

AND A TRES bon voyage we hope it will be for you who are participating in the Society's first post-convention cruise party. You're expected to be aboard the *Queen of Bermuda* at two o'clock Saturday. This will give you plenty of time to have your sailing pic-

ture snapped for your home town paper, get settled in your room and be back on deck for the serpentine throwing and farewells when the ship casts off from her pier on the Hudson at the foot of West 55th Street.

You won't need an extensive ward-

robe for dressing will be informal both at sea and ashore. In Bermuda dress as you would for spring at home.

If you can't decide which to choose from the islands' scenic attractions give priority to the lovely Leamingham and Crystal caves.

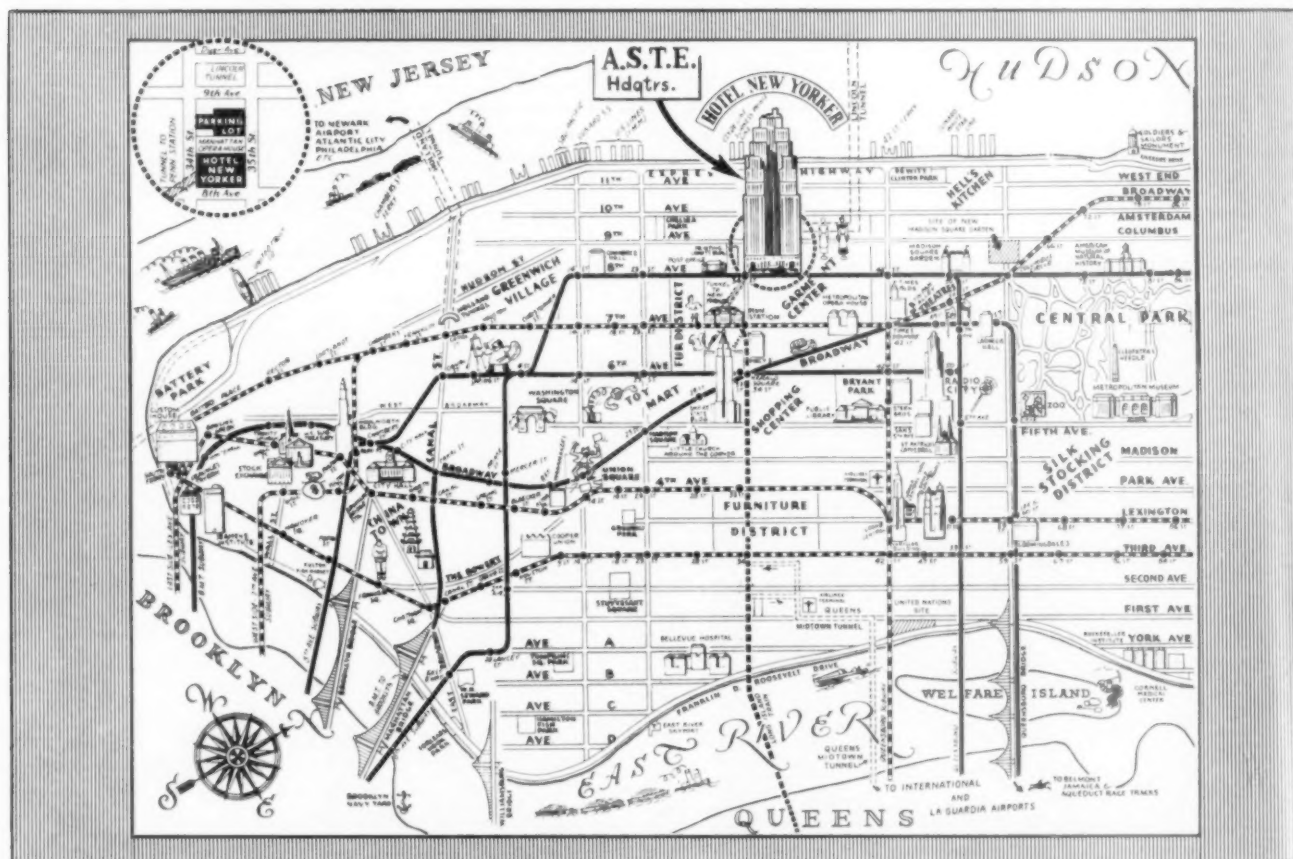
The government aquarium of tropical marine, bird, and animal life at the Flatts Village should rank high on your list.

At the present rate of exchange, you can splurge on shopping for foreign goods. With \$2.82 American you can buy anything with a £1 price tag. You'll get used to thinking in terms of "thruppences," shillings, "two and six's," instead of four, 14 and 35 cents. If you're a philatelist, you'll go for the full set of pictorial stamps for 64 cents.

Flower shops will pack your Easter lily buds and deliver them to the ship so that they'll be fresh and ready to open when you arrive home.

But don't forget your citizenship identification. Otherwise you may have a tough time getting back into the States. And don't smuggle. Customs officers know all the tricks. Besides they'll let you bring in \$200 worth for free, in limited quantities.

In New York Take Bearings From This



Membership Petitions Nominate Four for Director

Four candidates for national director have been added to the slate submitted by the ASTE Annual Nominating Committee. These men have been nominated by membership petition as provided in the Society constitution. Their names and qualifications follow:

Jay N. Edmondson—Professor of Industrial Engineering, Ohio State University, Columbus, Ohio. Senior member since 1941. Has served as first vice-chairman, second vice-chairman and chairman, Program and Education committees, Columbus chapter. In-

merce in 1946 as "Outstanding Young Man of the Year."

National authority in the field of induction heating and tooling requirements thereof. President, Cleveland Technical Societies Council. Registered Professional Engineer. Broad technical and executive experience. Has B.S., M.S., and Ph.D. degrees.

R. B. Douglas, nominating chairman, and his committee, **R. W. Bayless** of Peoria, **A. J. Schmidt** of Northern New Jersey, **A. M. Schmit** of Toledo, and **J. M. Speck** of Des Moines chapter,



H. B. Osborn, Jr.



H. D. Hiatt



J. N. Edmondson



L. F. Hawes

cumbent chairman, National Education Committee (two terms). Holds B.S. degree in General Engineering. Registered Professional Engineer. Active in other civic and technical organizations.

Leslie F. Hawes—President, Southern California Metal Spinning Co., Inc., Inglewood, Calif. Senior member since 1944. Has held various chapter offices culminating in chairmanship. Former member, National Public Relations Committee and member, 1948 Cleveland Exposition Committee. Director, Technical Societies Council of Southern California. Outstanding experience in aircraft and western manufacturing, tool engineering. Registered Professional Engineer.

Harold D. Hiatt—Supervisor, tool engineering and equipment, Allison Div., General Motors Corp., Indianapolis, Ind. Charter member and chairman, Racine chapter. Assisted in formation of Milwaukee chapter. Has been active in Indianapolis chapter offices, including chairmanship. Is permanent chapter historian. Past national director, and former member, National Education Committee. Has held responsible positions in industry.

Harry B. Osborn, Jr.—Technical director, Tocco Div., Ohio Crankshaft Co., Cleveland, Ohio. Senior Member since 1943. Has served in numerous chapter capacities including chairmanship. Past chairman, National Public Relations Committee (2 terms). Incumbent chairman, National Membership Committee (2 terms). Active in civic and technical organizations. School board president; elected by Cleveland Junior Chamber of Com-

merce in 1946 as "Outstanding Young Man of the Year."

have issued a supplement to their report, authorizing consideration of these members as qualified candidates.

The annual election of directors will be conducted at the house of delegates meeting in New York, March 14.

Morris Named Head of Ordnance Machine Tool Panel

Springfield, Mass.—A former ASTE president has been appointed chairman of the Machine Tool Panel of the Springfield Ordnance District. **Ray H. Morris**, president of Ray H. Morris & Co., West Hartford, Conn., heads up the recently reactivated panel of tool advisors and consultants to the Ordnance Department.

Lee R. Davis, Connecticut representative of Stedfast & Roulston, Inc., West Hartford, is vice-chairman of the present group.

Other Springfield and Hartford chapter members on the panel are: **Arthur H. MacBriar**, machine tool dealer of Longmeadow, Mass.; **C. Bruce Price**, Western Massachusetts representative for Stedfast & Roulston.

James D. Allan, machinery sales manager, Pratt & Whitney, **Carl W. Atwood**, district manager, Norton Co., **Robert S. Granfield**, Connecticut manager, Rudel Machinery Co., **Melville L. Merrill**, machine tool dealer, **A. Douglas Proctor**, Connecticut representative, **Harrington-Wilson-Brown**, and **Owen C. Stevens** of O. C. Stevens Co., all of West Hartford.

C. H. Hamilton, sales engineer,



R. H. Morris

Nylon Parts Resist Wear, Machine Easily

Pittsburgh, Pa.—Nylon parts have the advantage of being readily machineable, combined with exceptionally high resistance to wear and good resistance to corrosives.

C. W. Wall of the development and service section, polychemical department, E. I. DuPont de Nemours & Co., Philadelphia, made this point in a talk, "Plastics in Industry," at the January 5 meeting of Pittsburgh chapter.

Progress in developing nylon as a base material for bearings, wear parts, and in other applications was pictured in slides shown by Mr. Wall.

G. C. Wood, chairman, presided. **W. B. Peirce** presented a report of the Scholarship Committee. **Fred Hennig** reported an attendance of 225 members and friends at the Christmas party. A committee was elected to nominate candidates for chapter officers.

Orville K. Kallin, Sr., formerly of the Saginaw Valley chapter at Flint, Mich., was introduced as a new member of the chapter. Mr. Kallin is now associated with the Fisher Body Div. in the Pittsburgh district. **George E. Ryckman**, who has transferred from the Hamilton, Ont. chapter, also was introduced.

Henry & Wright, Hartford, and **Harry J. Hauck**, vice-president and chief engineer, The Goss & DeLeeuw Machine Co., Kensington, Conn.

During World War II ASTE members were prominent in these panels throughout the various ordnance districts. At that time Mr. Morris was chairman of a sub-committee on perishable tools. He, Mr. Davis and Mr. Merrill received citations for "distinctive service to their country . . . by making a marked contribution through their initiative and ingenuity . . . to vital war production for the conservation of critical materials and machines."

For their part in this voluntary, uncompensated service, Mr. MacBriar and Mr. Stevens received letters of commendation from the department.

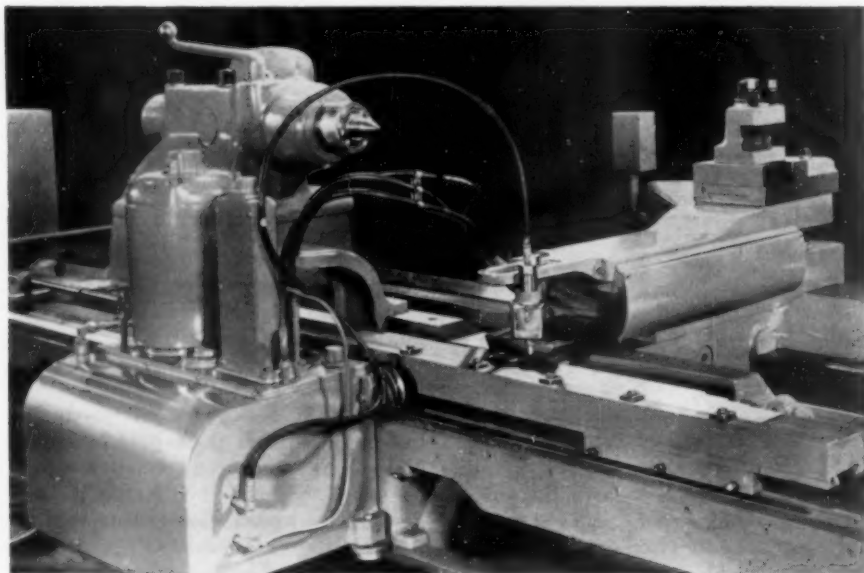
Schmidt Joins Ingersoll

Chicago, Ill.—**Thur Schmidt** of Chicago chapter has been appointed assistant to the president, Ingersoll Products Div., Borg-Warner Corp. Mr. Schmidt previously was general manager of the Highway Steel Products Co., Chicago Heights.

During World War II he served as consultant in research and development operations with the Quartermaster's staff.

Tools of Today.....

Air Gage Tracer By Monarch



Announced by Monarch Machine Tool Co., is a single-cylinder "Air-Gage Tracer" designed for use on Monarch 12, 16, and 20 in. Series 60, Models M, N and NN Monarch engine lathes. Identified as Type C, this improved design incorporates an in-built hydraulic cylinder and a power unit which travels with the carriage on a track at the rear of the template support.

The travelling power unit introduces several advantages, the most important being that there is no practical limit on the length of lathe bed to which the unit can be applied. Shortened air and hydraulic lines also increases accuracy

of its operations and improves the overall appearance of the installation.

Because the template support rail is mounted low at the rear of the bed, and the tracer supporting arm extends to the rear beneath the workpiece, extra large and long work may be loaded and unloaded with the ease incidental to conventional lathes. Since ample power to hold and drive the cutting tool is provided by the hydraulic cylinder, rate of feed and depth of cut are limited only by the cutting tools and the size of the lathe used.

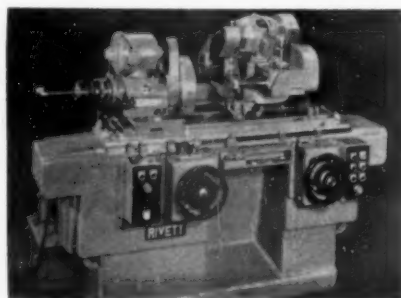
Complete details of this Air-Gage Tracer may be had from Monarch Machine Tool Co., Sidney, Ohio. **T-3-901**

Hydraulic Grinder

Rivett Lathe & Grinder, Inc., Brighton 35, Boston, Mass., now offers a Hydraulic Grinder which, as stated by the manufacturer, features a truly universal wheelhead. Swiveling 180 deg and mounting both internal and external spindles, the wheelhead on this No. 1024 grinder is designed to eliminate dual work setups for either or both internal and external grinding operations. The operator can readily present either spindle to the workpiece.

The machine has been designed to perform all types of grinding within its

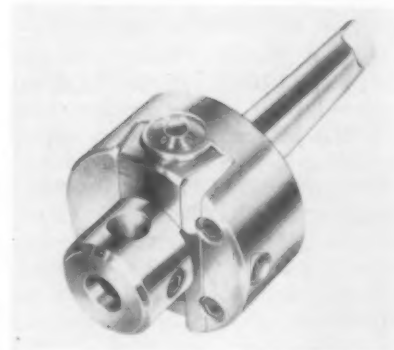
range. Internal work includes small, large and deep-hole grinding, while external work includes straight shaft, diameter and shoulder grinding. A feature that provides added accuracy



and speed is the mounting of draw-in collets and step chucks directly in the lathe-type workhead and in the operation of a lever closer to reduce chucking time.

Also featured is a spindle speed range from 6000 to 35,000 rpm; all spindles life lubricated; micrometer table stop and fine feed for shoulder and blind hole grinding; sine bar for setting the workhead on table swivel for precision grinding of tapers; and double swivels on the cross slide for two-angle internal and external grinding. With thought to operator convenience, all grinding wheel feed controls are at the operator's right, all table traverse controls at the left. This machine is fully described in Rivett Bulletin No. 1024-A. **T-3-902**

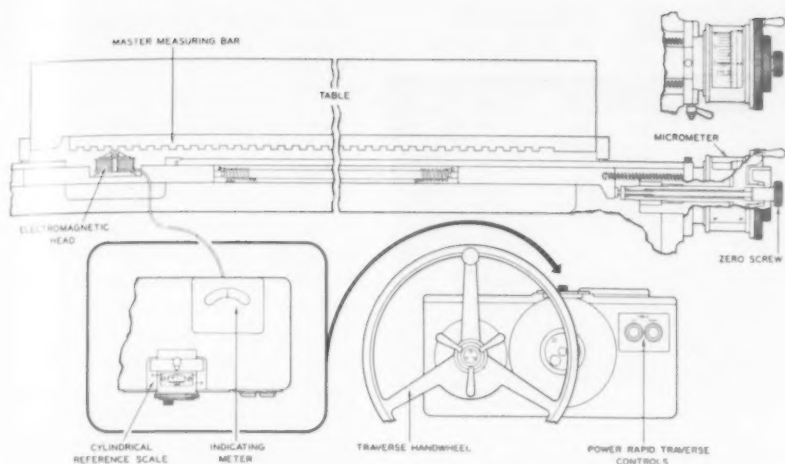
Boring Heads



Five offset Boring Heads have been added to the line of tools by Flynn Manufacturing Co., 133 Flowerdale, Ferndale, Mich. The added heads will be identified as the "40 Series" and carry the model numbers 43, 45, 47, 48 and 49. Of light-weight design, the smallest—model 43—is 2¾ in. diameter, has ½ in. bar capacity and weighs 3 pounds. The largest—model 49—is 6½ in. diameter with 1½ in. bar capacity and weighs 24 pounds. Bar offset of the series ranges from ⅝ to 1½ in.

The series features safety-smooth, round contour, and precision micrometer offset adjustment. The boring tool may be inserted in the head either vertically or horizontally. **T-3-903**

TO REQUEST ADDITIONAL
INFORMATION USE READER
SERVICE CARD
ON PAGE 121



Pratt & Whitney Improved Jig Borers

Pratt & Whitney's No. 4-E jig borer—the "Colossus"—now employs a novel measuring system predicated on the P & W Electrolimit gaging system and here designed for accurate location of large work under the spindle. Hence its designated name—the "Electrolimit Measuring System."

Better illustrated by diagram, as shown, than by photograph, the system incorporates basic 1 in. spacing obtained from a master measuring bar by electrical means without making physical contact with the bar. The master bar has rectangular projections so calibrated that their magnetic centers are precisely 1 in. apart, all within a claimed tolerance of only 0.00002 in. accumulated error in the full length of the bar.

The basic 1 in. spacing is further subdivided by positioning the electromagnetic head between any two projections on the master bar with a high-

precision micrometer screw. A $4\frac{1}{2}$ in. diameter micrometer barrel, with widely spaced graduations, permits easy reading for direct settings to 0.0001 in. A separate screw, within the micrometer, is used to "zero" the electromagnetic head when establishing initial zero of the workpiece. Cylindrical reference scales, read in either direction and adjustable to set zero for starting

position, revolve as the table moves and are so used to rapidly locate the table to approximate settings.

Also, by Pratt & Whitney, is the innovation of a spindle quill "roll feed" incorporated in the company's Nos. 2A and 3B jig borers. As the phantom illustration shows, this consists of some 240 precision steel balls preloaded between the spindle quill and two precision-lapped steel liners, the latter installed by deep-freeze. Despite the high bearing pressure—about 6000 lbs. between quill and liners—claimed sensitivity is such that an operator can easily get the "feel" of a $\frac{1}{8}$ in. drill feeding into the work.

Added features of these jig borers include a built-in dial indicator which, reading to 0.0005 in., replaces the old type depth measuring indicator; an adjustable pointer which shows at a glance the depth of bore; a binder for locking the quill when milling; and a depth stop which can be set to repeat a depth position anywhere in the full travel of the quill. Complete information on these developments may be had from Pratt & Whitney, Division Niles-Bement-Pond Co., West Hartford 1, Conn.

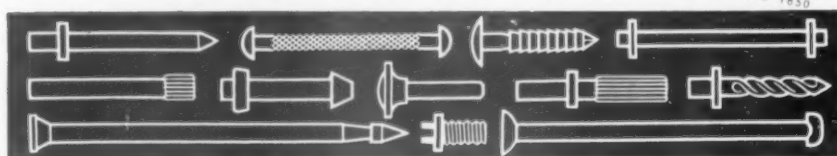
T-3-911

SPECIFY Hassall specially engineered fasteners

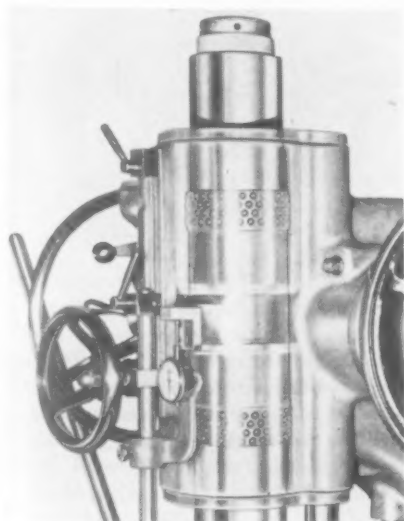


Hassall cold-headed fasteners can improve your products and save you money, even on short runs. Send us your specifications for your nails, rivets and screws... in diameters from $\frac{1}{32}$ " to $\frac{3}{8}$ "... lengths up to 7"... in any workable metal... in practically any finish. Your inquiry will be handled promptly. Ask for free catalog.

JOHN HASSALL INC. 130 Clay Street
Brooklyn 22, New York



FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-91

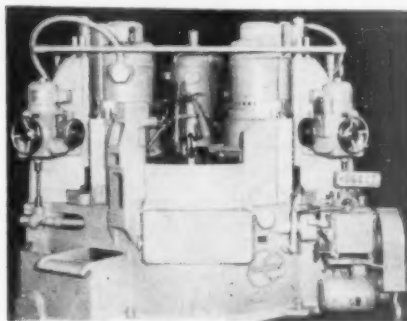


Rotary Table Grinder

The Blanchard Machine Co., Cambridge 39, Mass., announces their No. 163A vertical spindle Rotary Table Surface Grinder, available with a magnetic chuck 40 in. in diameter, or with a plain table to accommodate fixtures to hold non-magnetic parts. Maximum swing over work is 49 in.

The grinder is equipped with three abrasive wheels, all of which can be set to grind the same surface when stock removal is heavy or when close dimensional accuracy with high surface

finish is required. If desired, one spindle can be set to grind a surface at the



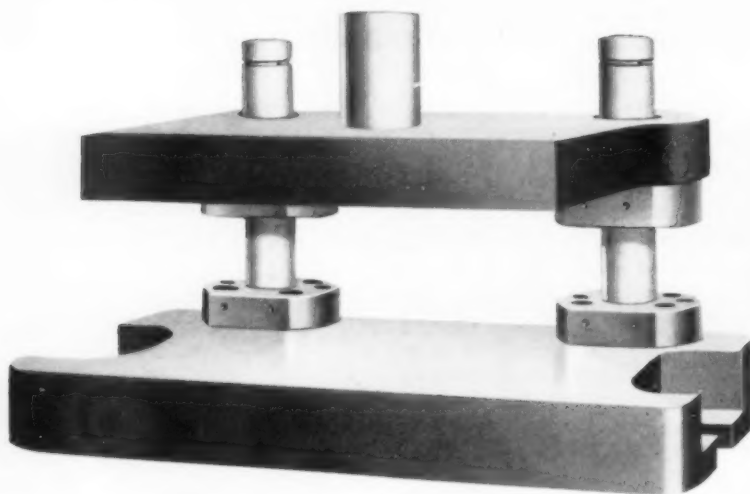
same or a different height and at a different distance from the center of the chuck.

The grinder shown is equipped with two spindles driven by 30 HP motor and one by a 15 HP motor. This grinder is "tooled" with a Blanchard designed 24-station fixture arranged to grind connecting rods with wrist pin boss at an offset height. Clamping and release is automatic. The grinding wheels are under control of one automatic caliper designed to hold dimensional variations within a total range of 0.001 in.

T-3-921

No Other Die Sets Like

BAUMBACH



Because of the patented demountable leader pins and bushings which are hardened, ground and super finished for accuracy and durability.

Baumbach precision built die sets have been serving industry for 40 years and through better quality and prompt service has become the foremost producer of die sets.

An important advantage of Baumbach die sets is our method of fastening the leader pins and bushings to the die shoes and punch holder. Other cost cutting features are the ease of regrinding, counterboring or machining. No leader pins in your way.

Write for catalog B-50. It contains much valuable information about die sets.

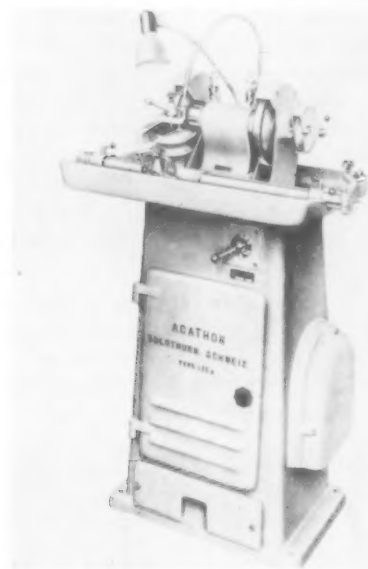
E. A. BAUMBACH MFG. CO.

1816 SOUTH KILBOURN AVENUE • CHICAGO 23, ILLINOIS
TELEPHONE CRAWFORD 7-4041

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-92

Grinder and Lapper

Hauser Machine Tool Corporation, 30 Park Ave., Manhasset, N.Y., has now making available to U.S. industry the Agathon type 175A Tool Grinding and Lapping Machine which, through its novel principle of grinding and lapping, is said to eliminate the necessity of checking and rechecking tool angles. The tool to be ground is held in a special compound holder which slides on a bar parallel to the wheel spindle so that, after grinding each surface of the tool, it is only necessary to move the holder to the lapping wheel for a final finishing job.

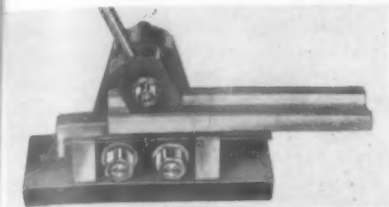


As claimed, tools of the smallest cross section and up to 1.57 x 2.36 in. can be rapidly ground and lapped to high accuracy. Wheels are readily changed for HSS or hard metal tools and a flexible coolant nozzle allows the operator to direct a stream of coolant to the precise spot desired. Provision is made for grinding chip breakers and curlers, and special attachments allow for accurate grinding and lapping of cutter heads, engraving tools, round boring tools and other special tools.

T-3-922

Channel Marker

The Cunningham CM-50 channel marking machine has been developed for stamping trade name, address or other identification on aluminum or other metal channel sections; specifically, for code identifying aluminum storm doors and windows. However, the equipment also can be produced for stamping small steel or aluminum channel sections of practically any shape.



Pulling the handle from left to right rolls a deep, clear-cut mark in the channel without distorting the metal. A spring then returns the mandrel to position for the next marking. The roll die can be made with lettering engraved on the solid roll and interchangeable type set-ups can be provided for part numbers or other changing identification marks.

Additional details may be had from M. E. Cunningham Co., 169 E. Carson St., Pittsburgh 19, Pa. **T-3-931**

Coolant Unit

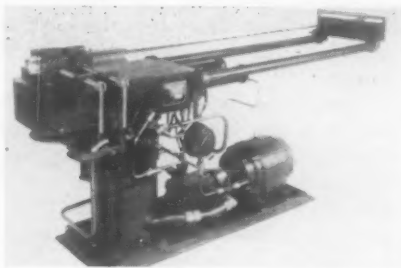
Announced by Delta Power Tool Div., Rockwell Mfg. Co., Milwaukee 1, Wis., is the Delta-Milwaukee coolant pump and tank. The centrifugal pump, mounted on a 16 gallon tank, delivers 6 to 32 gallons of coolant per minute—said to be sufficient to meet the needs of an 8-spindle multiple-drill press.



The 1/4 hp motor, mounted directly on the pump shaft, is fully enclosed for protection against moisture and caustic solutions, and a settling basin and wire-mesh screen keeps the coolant free of chips. The equipment includes a nozzle, valve, column mounting clamps and flexible hose assembly. **T-3-932**

Hydraulic Bender

Wallace Supplies Mfg. Co., 1300 Di-versey St., Chicago 14, Ill., announces the No. 800 hydraulic bender designed



for bending steel tubing up to 1 1/4 O.D. x 16 ga. wall. The unit is powered by a 2 hp motor, furnished with the machine.

Operation is by a single lever which, when pushed down, causes the bending arm to swing around to the degree of bend selected and to stay there until the operator has removed the bent part. The lever is then moved up, when the arm swings back to starting position.

A combination 4-size bending die is readily changed to suit different sizes of tubing, and the bender itself can be quickly changed from left to right bender, and vice versa. **T-3-933**

Hammond

OF KALAMAZOO

CARBIDE TOOL AND CHIP BREAKER GRINDERS

Save
TIME
TOOLS
WHEELS



CB-77 Chip
Breaker and
Diamond
Finishing
Grinder



WD-10 Wet
or Dry 10"
Carbide
Tool Grinder



14-WD Wet or Dry 14"
Carbide Tool Grinder

Hammond Carbide Tool Grinders will soon pay for themselves thru greater wheel economy, longer tool life and **FASTER** grinding. They relieve toolroom bottlenecks and step up production. **Write for Carbide Grinder Catalog.**

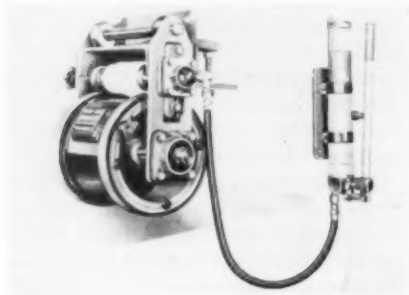
Hammond
Machinery Builders
INC.

1661 DOUGLAS AVE. • KALAMAZOO, MICH.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-93

Automatic Printer

Developed in cooperation with strip steel mill engineers by the Jas. H.



Matthews Co., 3942 Forbes St., Pittsburgh, Pa., is a Coil and Sheet Printer designed for automatic imprinting of trademarks, heat numbers and inspectors' identification marks on each sheet or coil as it emerges from temper units or shear lines. Thus, it replaces slower marking with a hammer-style rubber stamp.

Fundamentally, the unit is a revolving cylinder incorporating a rubber printing die. As the cylinder is rotated by the rubber drive tires in contact with the travelling steel, a clear, legible inked impression is made. The unit is suitable for permanent or water soluble

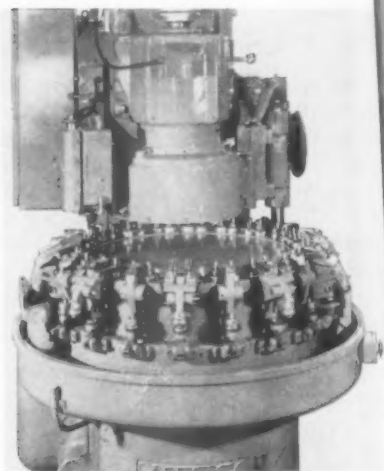
marking on steel run or temper hot or cold reducing mills, or continuous galvanizing lines for marking surfaces. Or, it can be mounted directly over the coil at the reel. T-3-8

Coolant Addition

Greatly increased coolant efficiency is claimed for Hydrodyne a multiphase wetting agent developed by Aquadyne Corp., 200 E. 42nd St., New York, N.Y. Utilizing the basic principle of "wet water," one part of the compound is added to 1000 parts of coolant reducing its interfacial tension and assures intimate contact with working surfaces and further speeds dissipation of harmful heat. The "wet" coolant, with its lowered surface tension is said to penetrate the finest crevices which ordinary coolant droplets cannot reach. Literature available from the manufacturer. T-3-8

Rotary Surface Grinder

The No. 24A Rotary Surface Grinder by Mattison Machine Works, Rockford, Ill., is designed for finishing both ends of workpieces simultaneously—that is, the workpieces are inverted after the first circuit under the wheel, after which grinding is continuous. The work is manually loaded and automatically ejected on completion of the grinding cycle.



The Hanchett-type machine illustrated is equipped with special fixtures for grinding both ends of oil pump gears, the work being constantly checked by an automatic sizer which keeps all pieces within specified tolerances without attention on the part of the operator. Fully described in a comprehensive bulletin. T-3-943

USE READER SERVICE CARD ON PAGE 121 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

The Busiest Name in Metal Cutting

CIRCLE R

Circular Metal Cutting Tools

CIRCULAR TOOL CO., INC.

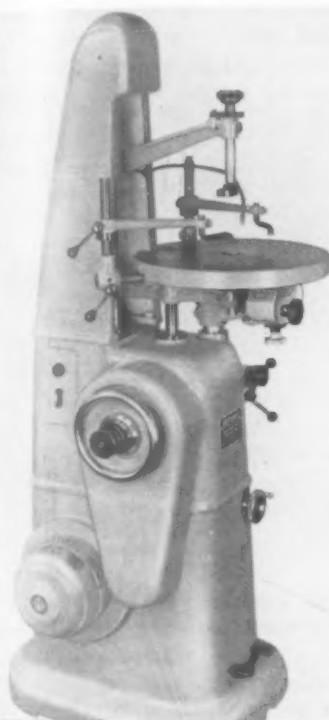
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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-94

Die Making Machine

The Connecticut Tool & Engineering Co., 544 Iranistan Ave., Bridgeport 5, Conn., announces the Model F3 Williams Punch & Die Making Machine. Superseding a previous model and designed for finishing operations on punch presses and extrusion dies, this machine incorporates features said to provide ease and speed of operation.



Design includes a foot pedal for instant control of operation; a compound tilting table with vernier scale reading; 5 in. stroke and table adjustment. A heavy 17 in. table is counterbalanced. Attachments are provided for light and heavy tension and compression files; holders and guides for fine or jewelers' saws; and adapters for honing or stoning.

T-3-951

Multi-Purpose Grease

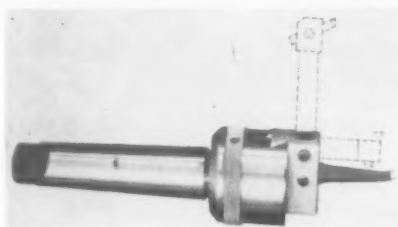
An oxidation inhibited, multi-purpose grease—Cosmolube—said to meet practically all the grease needs in the average industrial plant, is now offered by E. F. Houghton & Co., Philadelphia 33, Pa. An outstanding feature claimed for this grease, which makes it highly versatile, is its resistance to high heat, cold or wet conditions.

A cold-milled grease of a smooth texture, with excellent oxidation stability, it clings well to all metal surfaces and reduces leakage to the barest minimum and, as claimed, will outlast ordinary lubricants even under severe operating conditions. Cosmolube is available in two consistencies—NLGI No. 1 and No. 2.

T-3-952

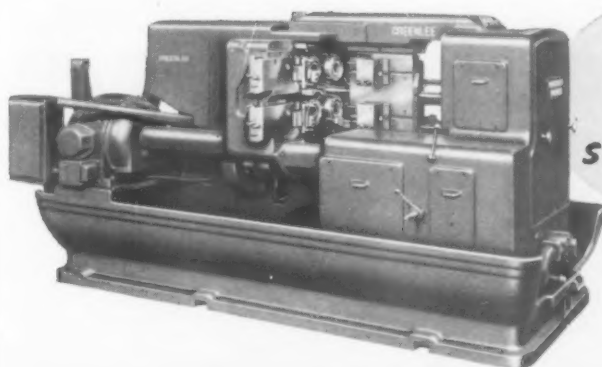
Improved Boring Tools

As announced by the Maxwell Company, 250 Broadway, Bedford, Ohio, E-Z Set boring tools have been improved



for easier setup and operation, and increased accuracy. Larger dovetail areas, with both members ground, increase tool rigidity and eliminate distorting slots and gibs, and micrometer-like adjustment holds claimed accuracy to within 0.0002 in.

Fabricated of high-alloy steels, the tools are circular and smooth for safe operating and ease of handling. Steep angle threads, on the scroll mechanism, have been modified with square-type threads to reduce backlash and to augment rigidity and accuracy. The tools cover a range of $\frac{3}{8}$ to 20 in. T-3-953



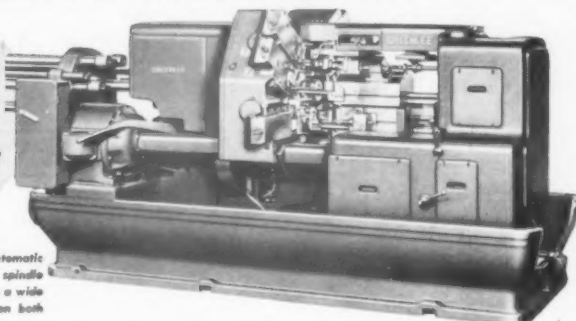
4
SPINDLE

THE GREENLEE "FOUR"
A heavy-duty automatic made in 1½" and 2½" spindle capacities. The "Four" incorporates all the cost-cutting features of the well-known "Six" (see below).

GREENLEE

AUTOMATIC SCREW MACHINES

6
SPINDLE



THE GREENLEE "SIX"
A ruggedly-built, high-speed automatic ... available in 1", 1½", and 2" spindle capacities ... capable of handling a wide range of work ... widely used on both short and long-run jobs.

OUTSTANDING FEATURES OF ALL GREENLEE AUTOMATICS

Write for literature describing in detail all the features of Greenlee Automatics.



UNIVERSAL TOOLING — Tool holders fit any cross-slide cavity ... are easily and quickly changed ... reduce equipment costs.

INTERCHANGEABLE CAMS — Can be changed at will without re-adjustment of tools and holders. Cam storage is held to a minimum ... cam costs greatly reduced.

BUILT-IN THREADING DRIVE AND FEED — Not an extra attachment, but standard equipment on Greenlee Automatics.

BUILT-IN COOLANT SYSTEM — Eliminates cumbersome piping in tooling area ...

GREENLEE BROS. & CO., 1983

gets coolant right where it does the most good.

LARGE TOOLING AREA — Permits using many timesaving, cost-cutting auxiliaries that often eliminate second operations. Various special adaptations of standard Greenlee Automatics can be made ... for handling second-operation work ... for tooling extra-long work pieces ... for multiple feed-out arrangements, etc. Send us details of your work. Let our engineers show you how profitably Greenlee Automatics can be applied to your production.

Mason Ave., Rockford, Ill.

MULTIPLE SPINDLE DRILLING, BORING, TAPPING MACHINES • AUTOMATIC SCREW MACHINES • AUTOMATIC TRANSFER PROCESSING MACHINES

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Frank A. Parker
19 Oakland Avenue
Auburndale 66, Mass.

NEWARK
Cinrock Machinery, Inc.
744 Broad Street
Newark 2, New Jersey

PHILADELPHIA
Hepworth Machine Tool Co.
2311-17 North 16th St.
Philadelphia 32, Pa.

HOUSTON
C. J. Harter Machinery
3838 Navigation Blvd.
Houston, Texas

HARTFORD
Frank A. Parker
30 Farmington Ave.
Hartford, Conn.

SEATTLE
Dawson Machinery Co.
5700-4 First Ave., South
Seattle 8, Washington

ST. PAUL
Sales Service Machine
Tool Co.
2363 University Ave.
St. Paul 4, Minn.

DALLAS
C. J. Harter Machinery
1501 Gulf States Bldg.
Dallas, Texas

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-95

Chrome Plating Unit

Ward Leonard Electric Co. Industrial Chrome Div., Mt. Vernon, N.Y., an-



nounces the Model A-20 Chromaster, and Chromasol. The Chromaster is designed to provide production industries with complete facilities for hard chrome plating metal surfaces up to 10 sq. in., at the recommended current density of 2 amps per sq. in. The average time to hard-chrome cutting tools and wear parts, to fortify them against chiploading and galling, is stated as about 1½ minutes, with the deposition controllable to tolerances of less than 0.0001 in.

Chromasol is a non-critical chrome plating solution shipped to the owner in concentrated liquid form. It is said

to deliver a hard chrome plate that follows the exact characteristics of the base metal to which it is applied, the rate of deposition remaining constant at 0.002 in. per hour. **T-3-94**

Adjustable Drill Jig

An adjustable Drill Jig, by Matheson Machine Works, Inc., 2 Hancock St., No. Quincy, Mass., is designed for drilling holes through round stock from ¼ to 2 in., and hex stock and screws from ¼ to 1 in. Suited to a variety of work, it eliminates the cost of special jigs for drilling jobs within its range.



The hardened Vee-block has a 90 deg V for round stock, and a 60 deg V for hex stock on the opposite face. Adjustable stops provide for longitudinal work location. An adjustable threaded bushing sleeve centered above the Vee holds slip bushings and also clamps the work to the block. Three bushing sleeves are provided to accommodate slip bushings of standard outside diameters. **T-3-962**

Die Sinking Cutters

Taper Die Sinking Cutters with full-cutting ball nose, now being produced in two types as stock items by Pratt & Whitney, Division Niles-Bement-Pond Co., West Hartford 1, Conn., are supplied ready to use with ball nose finish-ground to cut to dead center. No preliminary hand grinding is necessary.

Two styles of fluting are available: straight, for easy hand sharpening; and spiral, for users who prefer helical cutting characteristics and have mechanical grinding equipment. These cutters have a 7-deg taper—14-degree included angle—and are regularly furnished with right-hand cut and straight shanks. The ball nose has a radius equal to one-half the diameter of the small end, and blends smoothly into the taper. Complete listings and prices supplied upon request. **T-3-963**

ARMSTRONG



ARMSTRONG TOOL HOLDERS give lowest possible tool cost

The more operations you tool with ARMSTRONG TOOL HOLDERS, the greater your savings and profits. These permanent multi-purpose tools are low in initial cost. They give years of continuous service, reducing the direct tool cost per job to a matter of cents. Using small cutters or bits quickly ground from stock shapes they "Save: All Forging, 70% Grinding and 90% High Speed Steel." But greater still than these substantial direct savings are the indirect savings these tools effect. They reduce "tooling-up" to a matter of minutes—and costly delays and keep men and machines producing. Strong and efficient, they permit higher speeds and heavy feeds—machine more pieces per machine hour, machine more accurately, reducing losses through rejects or spoilage. Use ARMSTRONG TOOL HOLDERS for every operation on lathes, planers, slotters and shapers, on turret lathes and screw machines, to cut costs and increase profits.

Armstrong Tools are stocked by Industrial Distributors

Write for Catalog.

ARMSTRONG BROS. TOOL CO.

"The Tool Holder People"

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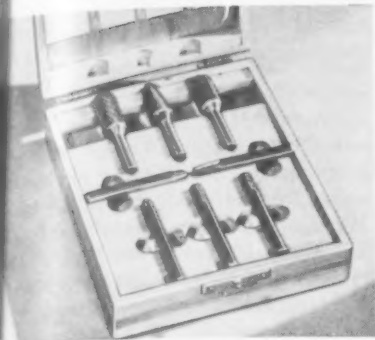
Chicago 30, U.S.A.

Eastern Whse. & Sales: 199 Lafayette St., N. Y. 12, N. Y.

Pacific Coast Whse. & Sales Office: 1275 Mission St., San Francisco 3, Calif.



FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-96



Midget Mills

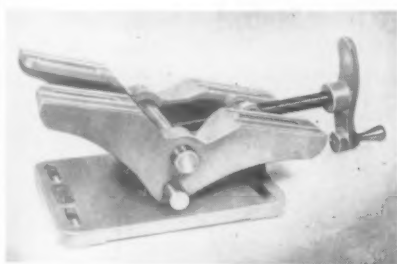
Severance Tool Co., Saginaw, Mich., now offers Di-Car Set No. 40 of carbide rotary cutting tools specifically designed for use by die and tool makers. Furnished with $\frac{1}{4}$ in. shanks, and nested in sets of eight in a sturdy case, the various cuts, tooth patterns and shapes have been selected to cover a wide range of applications on both soft and hard materials.

As stated by the manufacturer, the tooth pattern makes possible rapid stock removal with minimum annoyance from slivers; also, being of solid carbide, they may be reground repeatedly at a fraction of original cost.

T-3-971

Tilting Motor Base

The Lovejoy Flexible Coupling Co., 5232 W. Lake St., Chicago 44, Ill., announces a light-weight, low-priced, tilting Motor Base adjustable in width and length to accommodate all sizes and types of motors from fractional up to 1 hp.

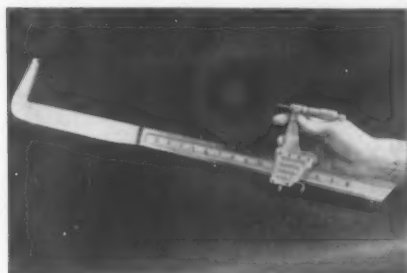


In addition to its use as an adjustable base for motors and variable speed pulleys, it also acts as a belt tightener and can be used for easy belt changing on cone step pulleys. Speed changes can be made while the machine is in motion. The unit measures $5\frac{1}{2}$ x 7 in., and shipping weight is 10 lbs. **T-3-972**

USE READER SERVICE CARD ON PAGE 121 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Adjustable Micrometer

Announced by the Lester Micrometer Co., 340 Cedar Ave., Cleveland 15,



Ohio, is the V-notch Adjustable Micrometer available in range 0-12, and 0-24 in. The frame—a tool steel blade—incorporates a series of Vee-shaped notches accurately spaced in 1 in. increments.

A carrier, sliding on the blade and holding a standard 1 in. micrometer head, is positioned in the desired notch and a spring clamp inserted. This accurately locks the carrier to the blade, the setting being automatic and repetitive. The spring clamp acts as a safety cushion should severe pressure be applied to the micrometer head. **T-3-973**

Ames HARDNESS TESTERS are on the job everywhere!

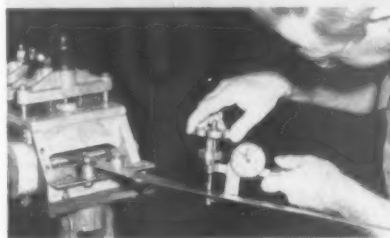
READ DIRECTLY IN
ROCKWELL HARDNESS SCALES

MODEL 4

For testing rounds and flats up to 4 inch capacity, in Rockwell A, B and C scales. Also made in 1 and 2 inch capacities.



Testing hardness of babbitt metal with Model S reading in Rockwell N and T scales.



Testing strip steel before fabricating — an important operation that insures against defective materials.

You'll find Ames Portable Hardness Testers being used in warehouses, machine shops, schools, on the production line, and in the field — where accurate, on-the-spot, time-saving hardness tests have to be made. No specimens to be cut off — no waiting for laboratory tests — because Ames Testers are light in weight and are carried to the work.

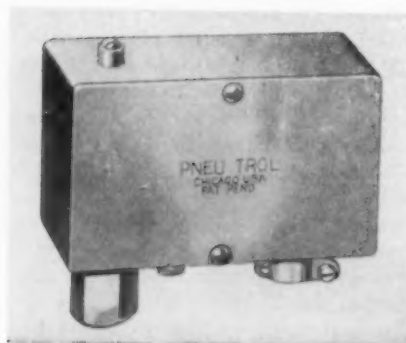
Ames Hardness Testers are used to determine machinability and workability of rods, strip and sheets before fabricating to prevent undue machine wear or tool breakage resulting from excessive hardness. They also are used on saws, knives, gears and large parts. A practical trouble shooter for any plant. No skill required to get accurate results. Testers come in convenient carrying cases.

More than 1500 in use.
Send for descriptive bulletin.

AMES PRECISION MACHINE WORKS
WALTHAM 54, MASS.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-97

Control Switch



A low-cost time delay Control Switch for solenoid valve controls used with air or hydraulic cylinders, is announced by Pneu-Trol Devices, Inc., 1435 N. Keating St., Chicago, Ill. Compact, and simple in design and operation, the switch is adjustable to provide delays within a $\frac{1}{4}$ to 10 second range. Resetting is automatic after each actuation.

Used to control machine dwell for spinning, blanking, spot facing, drilling and tapping operations, and for fixture loading in automatic cycle machines, its small size provides the advantage of being mountable close to mechanical stops

without interfering with machine movements. **T-3-981**

Knife Grinder

A 38 in. capacity Knife Grinder, for grinding and conditioning all types of straight knives and announced by the Michigan Defiance Company, Big Rapids, Mich., features a mechanical transmission which is totally enclosed and protected from dirt and foreign material. Another feature is the automatic table in-feed with adjustment from 0.0005 in. increments and up.



The grinder is sold complete with motor, starter, knife bar, set of clamps for thick and thin knives, grinding wheel, pulleys and belts. A specially designed wheel dresser, mounted on a fully machined and adjustable slide of heavy construction, is available at a small additional cost. A descriptive bulletin, No. MD-31, gives detailed specifications and data. **T-3-982**

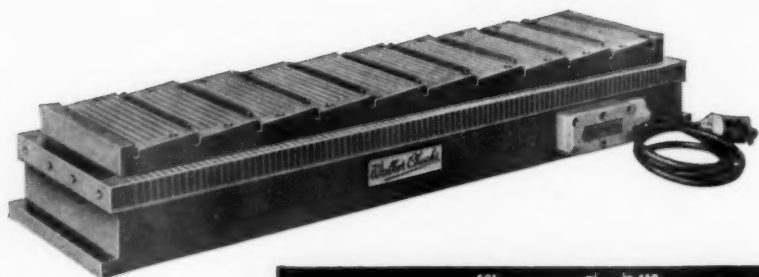
Carbide Scribes



A tungsten carbide Scriber—No. 454X—designed for use with Starrett Nos. 454 10, 18 and 24 in. vernier height gages, is announced by the L. S. Starrett Co., Athol, Mass. It is particularly applicable to scribing lines on hardened steel and other materials having a hardness below that of the scriber itself. **T-3-983**

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TOOLS OF TODAY INFORMATION

Walker Does It Again~



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2. Consult WALKER engineers
3. Your special problems can be solved magnetically
4. Results—greater efficiency
—lower unit costs

WALKER—with experience of over half a century—guarantees satisfactory results

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with Walker Chucks*

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WORCESTER 6, MASSACHUSETTS

Original Designers and Builders of Magnetic Chucks

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Dial Groove Gage

Nilsson Gage Co., Lake St., Poughkeepsie, N. Y., has redesigned its Dial Groove Gage, which now features a one-piece body to allow for interchangeability of extension arms to cover any range from smallest to largest sizes.



A self-positioning precision instrument, the gage is designed to provide positive control in checking diameters of grooves and recesses. Range settings, effected with a simple knurled vernier nut arrangement, can be made direct to gage block combinations or with a micrometer; however, a master check ring gage is recommended for high production runs.

T-3-991

Tool Accessories

Northwestern Tool and Engineering Company, Dayton 3, Ohio, announces that among other jig and fixture accessories they can now furnish a complete line of cast iron hand knobs with a black penetrate finish. The knobs can be furnished in both star and hexagon types, and plain, tapped or reamed in sizes $\frac{1}{4}$ to 3.4 in. inside diameter.

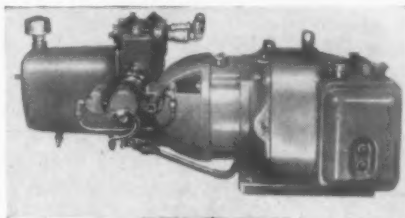
Also available from Northwestern are flanged nuts with a hardened finish in all standard sizes from 5/15 in. and up to and including 1 inch diameter. These nuts are intended to replace loose nuts and washers commonly used with fixtures.

T-3-992



Hydraulic Package

A completely packaged Hydraulic System, by Harco Industries, 20 Curtice St., Rochester 5, N. Y., is designed to meet the needs of small and large plants interested in building simple



hydraulic presses, jigs, fixtures and clamps.

Combining compactness with adaptability, the unit may be used as a complete, self contained hydraulic system or as a pilot system on large installations. Direct motor drive to pump eliminates belts and reduces maintenance costs; also, the design is said to minimize pressure flutter and overheating incidental to pilot pressures with large volume installations. Available in over 100 models in ranges 1.88 8.25 gpm, pressures up to 1000 psi.

T-3-993



Hole Location Practices

Published in the interests of greater accuracy and quality in the toolroom and on the production line by the Moore Special Tool Company, Inc., 732 Union Avenue, Bridgeport 7, Conn., builders of Jig Bore, Jig Grinders, Panto-Crush Wheel Dressers, Die Flippers, Motorized Centers and a complete line of Hole Location Accessories.

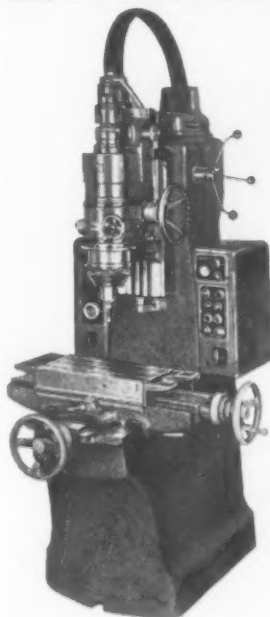


FIG. 1

Now...Jig-Ground Contours

When first conceived by Moore 12 years ago, the Jig Grinder was designed primarily to position accurately and grind cylindrical as well as conical holes, with taper in either direction. Continuing development and user-experience have since revealed a wider scope of applications particularly in grinding contours. Result: a completely redesigned and larger Moore Jig Grinder (Fig. 1)

VALUABLE BOOK FOR DEFENSE PLANT TRAINING



PRECISION HOLE LOCATION contains many examples of jig-boring and jig-grinding practices similar to one described here. 448 pages, 400 illustrations. Over 7500 copies of this authoritative book have been sold to date. 184 pages of Woodworth Coordinate Location Tables from 3 to 100 holes. Available at special price of \$3 in U.S.A., \$3.50 elsewhere. Send check or money order to Moore Special Tool Co., Inc., Bridgeport, Conn.

that contour grinds, chop grinds and slot grinds as easily as it hole grinds.

Press tools such as lamination and similar dies have various combinations of radii, tangents, angles, and flats, all of which must be accurately ground to size and location. The ordinary lamination die, shown in

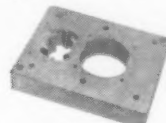


FIG. 2

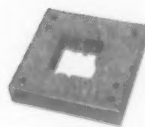


FIG. 3

Fig. 2, is an excellent example. The two-station section was ground complete with proper draft in only 25 hours. Previous time, including filing, stoning and template work, was 80 hours.

Every contour and surface was also checked in the Jig Grinder by coordinate measurement with the lead screws, an important feature of

Moore Jig Grinders and Jig Bore.

The right side of the blank die (Fig. 3) was ground with the regular grinding head. The corners, slots and projections on the remaining three sides were done with the new slot-grinding attachment (Fig. 4). Proper draft (including corners) was ground around the entire contour with the taper-setting attachment.

Ask for a free reprint of an eight-page article on the design of the No. 2 Moore Jig Grinder which appeared recently in MACHINE DESIGN.

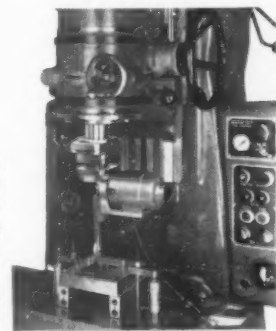
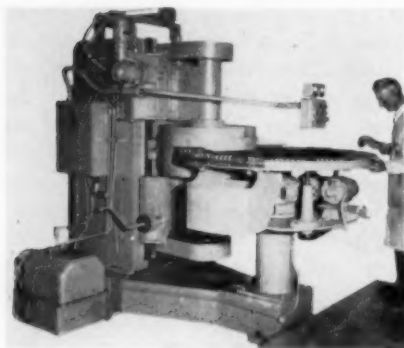


FIG. 4

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-99

Spring Grinder



Designed for faster and more economical grinding of springs with a corresponding increase in accuracy and quality, the Besly No. 928-30/60 vertical-spindle Spring Grinder features semi-automatic cycling together with special abrasive wheels constructed to grind materials ranging from bronze wire to oil-tempered steel. This feature eliminates down-time due to wheel changing.

Stressed by the maker is the grinding of springs from 1/4 to 4 in. in diameter in wire sizes ranging from 0.0625 to 0.500 in. Also stressed in conservation

of handling time since the machine produces finished springs at each cycle instead of the several passes needed for conventional spring grinding. Complete information on this interesting development may be had from Charles H. Besly & Co., 125 Clinton St., Chicago 6, Ill.

T-3-1001

Rubber Plasticizer

Of particular interest, in view of getting greater service from critical materials, is the claim of prolonged performance life of rubber parts by treatment with a unique rubber plasticizer announced by Schwartz Chemical Co., 326 W. 70th St., New York 23, N. Y.

When applied to old rubber surfaces which have become hardened, cracked and inelastic with age, it is said to actually plasticize the rubber and impart the feel, grip, and resilience of new rubber. Described as a non-inflammable and non-volatile liquid, which is absorbed by the rubber, one application is said to result in lasting improvement.

According to the manufacturer, the plasticizer called "Rub-R-Vive"—is said to be particularly applicable to renewing rubber feed rolls, platens and other industrial parts in addition to numerous other uses.

T-3-1002

Lettering Device

Designed to provide professional lettering is the Varigraph, by the Varigraph Company, Madison 1, Wis. Made of Tenite and measuring 7 x 7 in., the housing slides smoothly along a straight edge. The lettering pen point—at upper left—is operated by moving a stylus, shown at lower right, along letters engraved in an insertable templet.



Control knobs govern height and width of letters or numerals, and settings from 0.150 to 0.750 in. are provided for. As claimed for the device, hundreds of variations of any alphabet can be reproduced from one full-size templet. The templates come in more than 60 popular type faces. A feature of the device is that it can be readily used by a left-handed person. **T-3-1003**

HERE'S HOW NELCO CARBIDE CUTTERS HAVE SAVED TIME, MONEY - AND IMPROVED PRODUCT QUALITY FOR US! -



THE TRUMBULL ELECTRIC HAS INCREASED PRODUCTION OF THESE COPPER CONTACTS FROM 200 OR LESS, TO OVER 12,000 PER GRIND . . .

The Trumbull Electric Company has eliminated a troublesome production bottle-neck by adopting NELCO Carbide Cutters. Slotting copper contacts, a vital component of electrical switches carrying up to 600 Amperes, is a precision milling operation. Smooth, accurate cuts are as necessary as steady, dependable production. The change to NELCO Carbide Milling Cutters has not only resulted in amazing slotting operation output but has made possible substantial dollars and cents savings by practically eliminating down-time.

WRITE FOR CATALOG "CARBIDE TOOLS," TODAY!

NELCO TOOLS
For that Extra Edge in Production
NELCO TOOL CO. INC. • MANCHESTER, CONN.

PRODUCTION RECORD — HIGH SPEED STEEL CUTTER—from 30 to 200 pieces per grind.

NELCO CARBIDE CUTTER—from 6,000 to 13,000 pieces per grind.

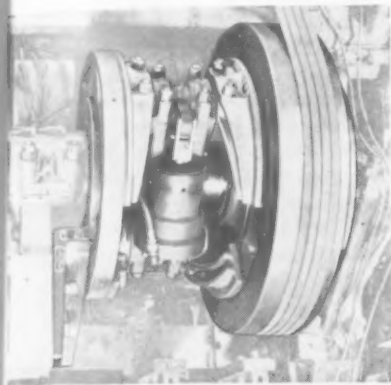
A normal increase from 300 slotted contacts per day to over 1,200 per day.



FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-100

Clutch-Brake Unit

An air-powered combination friction clutch and brake mechanism for driving power presses and other medium and heavy machinery is announced by Power Presses Inc., Penton Bldg., Cleveland, Ohio.



Among features stressed by the manufacturer is accessibility. Shoe and lining assemblies may be changed in a matter of minutes, without removing the unit from the machine, and all other wearing parts—driving mechanism, springs, pistons and packings—may be removed without disturbing other parts.

Design is directed toward safety. The entire unit is controlled by a solenoid valve which admits compressed air to the clutch, engaging it. In event of current or air failure, this valve immediately closes, permitting air to escape and causing the brake springs to disengage the clutch and apply the brake.

T-3-1011

Emulsion Cleaners

A cleaning process for all metals, developed by Northwest Chemical Company, 9310 Roselawn, Detroit 4, Mich., utilizes emulsion cleaners of the W/O type—based on petroleum products—to replace hot chlorinated solvent degreasing. In effect, this system is said to be equivalent to spraying the work with solvent while immersed in water, rather than in the air.

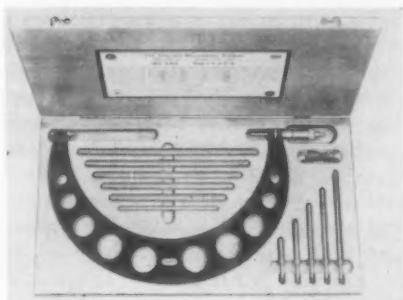
Since these emulsions are characteristically unstable, mechanical agitation—induced by propeller type mixers or by a pump and jet system—is required to maintain dispersion of the solvent in the water phase.

The process is adaptable to small shops and large plants for automatic or manual handling. Among other methods, parts may be kept right on the plating racks throughout the operation. Complete information on this interesting development may be had from the manufacturer.

T-3-1012

Micrometer Set

Announced by the L. S. Starrett Co.,



Athol, Mass., is the No. 224 Micrometer with interchangeable anvils in range 6 to 12 in. Six anvils are furnished with the micrometer, all readily interchangeable to provide the full range in steps of 1 inch. Each anvil is marked to show capacity and is fitted with an adjusting collar which compensates for wear and acts as a seat when clamped in position by a locking collar.

The complete set, which embodies all late Starrett improvements, consists of the micrometer, 6 interchangeable anvils, 6 standards, and wrenches. It is also available in other ranges 0 to 24 in., and in Metric.

T-3-1013

When Our Armament
depends on *Accuracy*
you can rely on
Thread Rolling



**Cylindrical Die
Thread Rollers**

**For Precision Threading
Knurling — Forming
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Serrating**

The proven ability of precision thread rolling to maintain the accuracy of the original setup during long runs of high speed component part production can help you reduce manufacturing, assembly and inspection costs.

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THREAD ROLLING MACHINES and DIES • KNURLS • THREAD ROLLS

Worcester 2, Massachusetts, U.S.A.

TE-019

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-101

"Hastelloy"

The Carpenter Steel Company announces the availability of tubing and pipe to handle oxidizing and reducing corrodents. Called Carpenter Alloys B and C, these tubular products are made from strip of the "Hastelloy" analyses, products of the Haynes Stellite Division of Union Carbide and Carbon Corp.

Outstanding characteristic of Alloy B tubing or pipe is said to be its unusually effective resistance to hydrochloric acid in all concentrations and at all temperatures, including boiling.

It is also recommended for sulphuric acid at temperatures above 80 deg C, but is not recommended for oxidizing atmospheres.

Because of its chromium content, Alloy C tubing will withstand strong oxidizing conditions such as those encountered with nitric acid, free chlorine, aqueous solutions of chlorine, and acid solutions of ferric and cupric salts. In addition, it will resist phosphoric acid and is highly resistant to acetic, formic, and sulphuric acids. Alloy C tubing and pipe are generally recommended for use with hydrochloric acid up to 50

deg C. Complete information about these products may be had from The Carpenter Steel Co., Alloy Tube Division, Union, N. J. T-3-1022

"Dimensionair" Gage

Outstanding advantages are claimed for the Dimensioner air gage—announced by Federal Products Corp., Providence 1, R. I. Provided with exceptional measuring range and clearance combined with what is stated as practically absolute stability, its 0.001 in. range enables a user to determine the size of a hole before reaching its ultimate size. Irregular and tapered holes are said to be even more readily gaged since the plugs can be inserted with jets at practically any angle with a minimum of centralizing error.



Setting of the gage is said to be rapid and positive, without fussy balancing of controls, and with stability such that, after the gage is in operation, drift is entirely absent even after the gage is in operation, drift is entirely absent even after a period of days. Air pressure, at 40 to 60 psi at the jets enables to plug to be used at production in coolants or oil without interference from dirt.

Dimensional variations are measured directly on a graduated scale, each graduation representing actually 0.00005 in. at amplification of 2500 to 1, and variations as small as 0.000005 in. are said to be readily determined. T-3-1022

Unloading Valve

Added to its line of hydraulic devices by Rivett Lathe & Grinder, Inc., Brighton 53, Boston, Mass., is a hydraulic unloading valve—Model 8826—designed for use in hydraulic circuits to unload one part of the circuit at no back pressure to the tank.

Featuring a balanced piston design for close accurate fit in the valve bore, this valve is operated by pilot pressure from some other part of the circuit. Free flow to the tank continues as long as the pilot pressure is higher than the setting of the valve. Fully described in Rivett catalog section 202.

T-3-1023



Immediate Delivery

This Swedish tool and die filing machine represents the latest development in tool makers' and tool engineers' equipment. Users of this precision tool report tremendous savings in time and tool life, due to its high efficiency and accuracy. It is a necessity in tool and instrument making and will save countless hours of production time since carbide and hard metal tools can be sharpened without removal.

A few of Di-Profile's advantages and uses:

1. For filing, honing, polishing and lapping on inner and outer surfaces.
2. For sharpening all hard metal and carbide cutters and tips.
3. Attaches to a flexible shaft for other handwork, such as rotary drill-ing, sawing and filing.
4. Driven by any 10,000 rpm controllable speed electric motor.
5. Adjustable stroke from 0" to 1/4".
6. Diamond files, needle files and circular diamond saws available or supplied as needed.

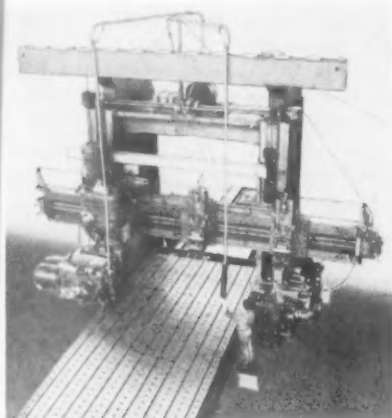
A few territories available to distributors or manufacturers agents.



Hypro Combination

Designed for multiple operations, a Hypro Combination Planer and Miller incorporates three planing heads and two milling heads to handle large workpieces up to 10½ x 9 x 26 ft. long. As announced by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., this Cincinnati tool combines engineering features designed to simplify setup and machining of extra-large parts and assemblies.

For increased flexibility, the right and left-hand planer head is mounted on the rail for individual or simultaneous operations. In addition, a right-hand planer side head is used to provide conventional advantages. The rail heads may be traversed to clear the entire table for a vertical milling head, also mounted on the rail. A left-hand milling side head augments the regular machine functions. Like the planer heads, both milling heads swivel and, being designed for heavy service, are individually powered by 25/50 HP 2-speed motors. Sixteen spindle speeds are provided.



The drive for feed and traverse to the table, for milling operations, is mounted on the right side of the machine and furnishes electronic feed in infinitely variable increments of 1 to 60 in. per minute. A similar drive, mounted on the arch, feeds the milling head saddles in infinitely variable increments of 1 to 40 in. per minute. The electronic feed is also available to the cross rail, in an up-and-down direction, at a rate of about ¼ in. to 10 in. per minute.

Also announced by G & L is a 12 ft. Cincinnati Vertical Boring and Turning Mill featuring pendant control electrohydraulic shift. Like the combination planer and miller, this machine is designed for extra large work and incorporates the latest developments in its class. Complete information on both machines may be had from the manufacturer.

T-3-1031

March, 1951

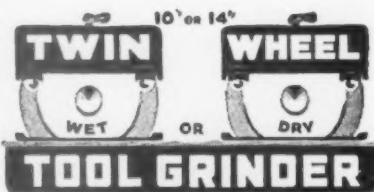
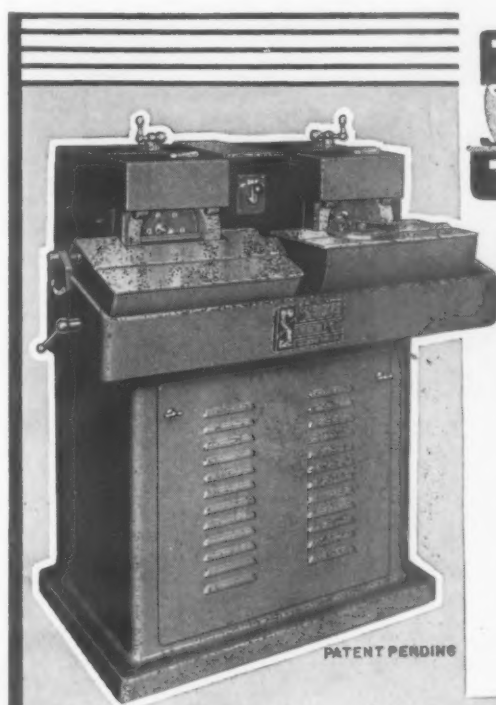
Power Shear

Following the recent announcement of its standard single-stroke Power Shear, O'Neil-Irwin Mfg. Co., 375 Eighth Ave., Lake City, Minn., now offers the recently engineered DI-Acro Vari-O-Speed Powershear. As the name implies, this tool is a variable-speed power shear designed for high-speed production within a speed range of 30 to 200 rpm.

The cutting speed of this precision shear can be quickly adjusted to the

fastest speed at which the operator can feed material for any given shearing operation. This provides maximum output since the end of engaging the clutch for each cutting stroke has been entirely eliminated. Incorporating a U.S. Varidrive Motor, the tool is offered in 12 and 24 in. sizes with a material capacity of 16 ga. sheet steel.

Complete information on this Shear, as well as other O'Neil-Irwin tools, is contained in the latest edition of the DI-Acro catalog, available from the manufacturer on request. **T-3-1032**



TOOL GRINDER

For Carbide, Stellite, or High Speed Steel Tools.

*one step
from rough
to finish grind*

Heavy Duty
Wet or Dry
10" - 14" Wheels

Type TD

10TD 10" - 14TD 14"

Twin Wheel Tool Grinder

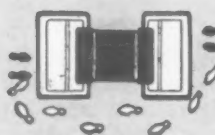
(Also SINGLE CUP WHEEL)

Also:

GRINDERS — ALL KINDS!
UP TO 100 H.P.

BUFFERS — POLISHERS
UP TO 60 H.P.

ABRASIVE BELT MACHINERY
SPECIAL MACHINERY

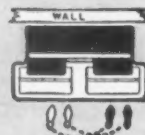


OLD WAY

Lost time between rough and finish grind.

Floor space wasted —
Grinder must be away from wall.

Positively no spray or splash when grinding wet!



NEW WAY

One step from rough to finish grind.

Conserve floor space —
place Grinder against the wall.

WRITE FOR BULLETIN 18 TODAY!

THE STANDARD ELECTRICAL TOOL CO.

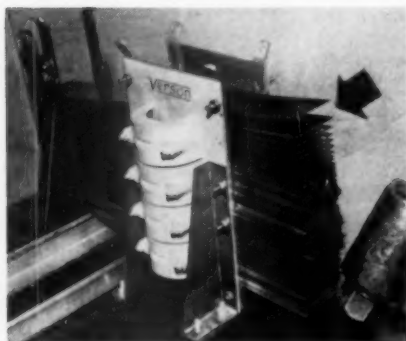
WRITE FOR BULLETIN 18 TODAY!

2499 RIVER ROAD

CINCINNATI 4, OHIO

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-103

Sheet Separator



Feeding of steel sheets, blanks and stampings into punch presses is now facilitated by the Sheet Floater, recently announced by the Verson Allsteel Press Co., 9336 So. Kenwood Ave., Chicago 19, Ill. Glove damage and injury to workers is also reduced.

Incorporating powerful Alnico magnets, together with a stainless steel mounting bracket and a stainless steel wear plate welded into a compact unit, the Sheet Floater induces a magnetic field in the sheets in such a manner that they repel each other, thereby causing the ends to float or "fan" out

with air spaces between. So separated, the top sheet can be readily grasped and fed into the press. **T-3-1041**

Finishing Machines

Announced by Hufford Machine Works, Redondo Beach, Calif., is equipment which, specifically designed to remove wrinkles from parts formed on rubber pad presses, should be of particular interest to the aircraft and allied industries. Two machines are employed, one of which employs a lead "slapper" to cancel out wrinkles.



A foot pedal releases air to a pneumatic clamp which secures the part and its respective form block to the steel table top. Depressing the pedal further actuates the slapper parallel to the table, when it strikes a series of blows along the edge of the workpiece until the surface is superficially smooth and wrinkle-free.

The part and its form block are then transferred to the Hufford planishing machine. This incorporates an air-driven hammer assembly, mounted on a smooth table top, which imparts a series of short, rapid blows to remove minor defects and produce a smooth, polished surface. Both machines are designed for full visibility during operation. **T-3-1042**

Flexible Shaft Tool

Barton Products, Inc., Defiance, Ohio, announces a low cost Flexible Shaft Tool which, while following conventional design, incorporates features particularly advantageous to die makers and others having to hand finish irregular contours.

Powered by a Black & Decker—or equal— $\frac{1}{4}$ HP 6000 rpm motor, with bail for hanging, the tool is provided with a cool-running ball-bearing hand piece and a high-speed flexible shaft approximately 4 ft. long. Complete with cord and switch and in a choice of either $\frac{1}{4}$ in. or $\frac{1}{8}$ in. collet. **T-3-1043**

USE READER SERVICE CARD ON PAGE 121 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

TRY

Glenzer

UTILITY
SLEEVES

They provide a REMOVABLE taper shank for straight shank drills, taps, countersinks reamers and other small tools. First introduced in 1919, more and more plants now specify them as standard. All the speed and convenience of taper shank tools, but instead of throwing away the entire worn out or broken taper shank tool, you retain the Utility Sleeve for use with dozens of straight shank tools.

Are You Using Them Everywhere You Should?

Customers report 40 to 75% savings in small tool costs after using these Sleeves. With rising labor and material costs, can you afford to overlook any further places to use them?

All Standard Tapers Supplied—Any Stock Size Sent on 30 Day Free Trial For Your Inspection and Work Out

THE J. C. GLENZER CO. Inc.

1552 E. NINE MILE ROAD, DETROIT 20, MICH.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-104

Power Shears

The power squaring shear line, by Columbia Machinery & Engineering Corp., Hamilton, Ohio, has been expanded to include a complete range in capacities $\frac{3}{16}$ in. thick to 12 ft. long; $\frac{1}{4}$ in. up to 14 ft.; $\frac{3}{8}$ in. up to 20 ft.; $\frac{1}{2}$ and $\frac{3}{4}$ in. up to 14 ft.; 1 in. up to 12 ft.; and $1\frac{1}{4}$ in. x 6 ft.



Since the construction of such heavy-duty equipment may be assured as adequate, with details available from the manufacturer, we will merely point out the more prominent design features. These include an air-operated disc clutch, installed in the flywheel and controlled by a solenoid through a jog or foot switch. Because the clutch is placed ahead of the gears, there is no motion in the gear train when the shear is not cutting. This reduces gear wear.

T-3-1051

Deep Throat Press

The 4-ton deep-throat punch press, by Benchmaster Mfg. Co., 2952 W. Pico Blvd., Los Angeles, Calif., has been re-engineered for greater dimensional capacity. Open height, ram up, has been increased to full 8 in. to permit use of higher dies and special tooling. The press now punches to the center of an 18 in. circle.

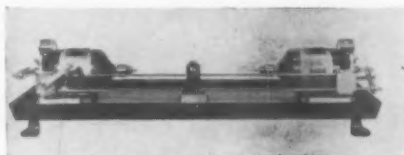
Frame construction has been strengthened at all stress points, and a knockout added. With exception of frame, trip link and legs, all parts have been standardized for interchangeability with the regular 4 ton model, thus facilitating replacements.

T-3-1052



Countersinking Machine

An improved Countersinking and Deburring Machine, by Black Drill Co., 1400 E. 222nd St., Cleveland 17, Ohio, now incorporates a positive-type tool-actuating mechanism. This innovation permits precision operation on a wide



range of work and up to the full 20 in. capacity of the machine.

The improved control is a treadle-operated rack and pinion traversing mechanism, each rack being provided with a micrometer adjustment which, with adjustment by set screws, limits travel of the motor shafts.

The power is transmitted to the opposed motors, their rotors automatically position themselves in the center of the stator magnetic fields and remain there. With the work in place, the treadle is depressed, when both drill heads advance into the work. **T-3-1053**

**SAVE MOUNTING COSTS
INCREASE PRODUCTION RUNS**

**WITH FACTORY ASSEMBLED
AND INSPECTED DIE SETS**

FACTORY-BUILT IS BETTER-BUILT

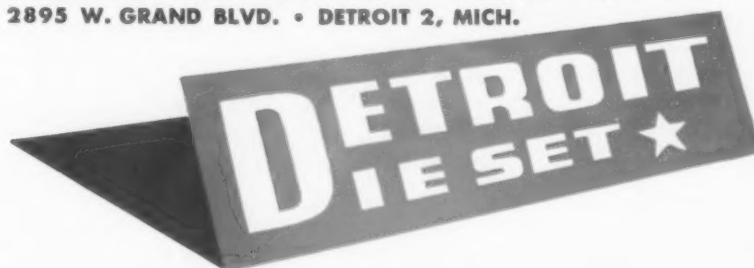
YOU are sure of built-in precision when you specify "DETROIT" die sets. Quality-built to start, every set is assembled and inspected at the "DETROIT" factory, where complete testing facilities are available. Precision standards are constantly maintained to enable mounting of die in die set in less time, and to obtain longer trouble-free production runs without necessity of regrinding. Phone nearest "DETROIT" representative for prompt delivery from factory.

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DETROIT DIE SET CORPORATION

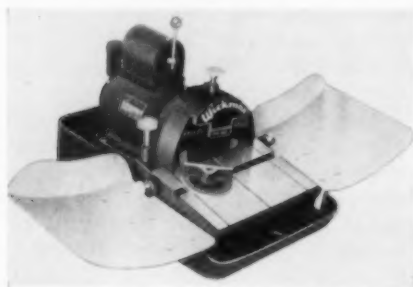
2895 W. GRAND BLVD. • DETROIT 2, MICH.



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Bench Grinder and Lapper

An improved bench Grinding and Lapping Machine designed to use a



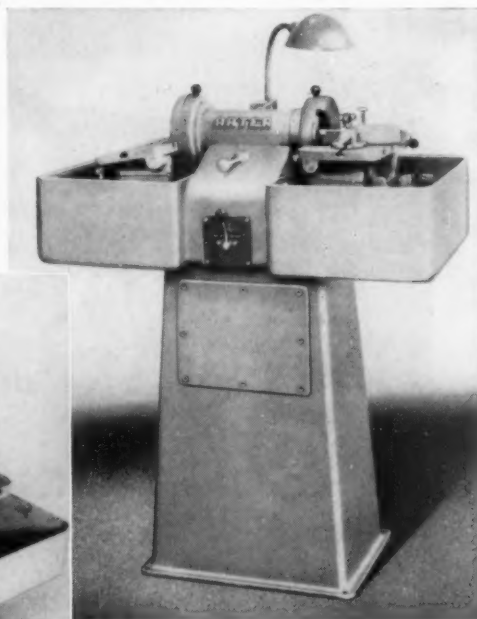
silicon carbide abrasive and diamond wheels, and particularly Wickman-Neven steel bonded diamond wheels, is announced by the Wickman Manufacturing Co., 15533 Woodrow Wilson Ave., Detroit 3, Mich.

Incorporating many of the basic features of the former GF-2 grinder, this Model GF-2A also includes a second wheel guard for use with ordinary abrasive wheels; a 3-position table to provide for wheel wear; a milled protractor slot; and an improved removable coolant filter. The wheel guards provide effective splash control.

ARTER

IMPERIA Carbide Tool GRINDER

MODEL 200



Off-hand grinding of tools is seldom a satisfactory operation. Hands are unsteady, tool shanks can be rough or not flat, work tables may not be smooth. The result—poor tool grinding, shorter life between grinds, possible damage to expensive diamond wheels.

ARTER IMPERIA CARBIDE TOOL GRINDER work tables are **movable**. Tables are held on two pivot-edged side plates by vertical tension springs, forming a flexing mounting. Very light hand pressure moves table and tool forward and back across the face of the diamond wheel. In-feed is made by a knurled knob bearing a graduated disc. The work tables can be

tilted to the required degree of angularity. Two protractor type graduated tool holders are standard equipment. When grinding chip breakers the wheelhead also can be moved up and down, a compression spring giving smooth easy action. This compact double-table machine can be set up for roughing and finishing tools, finishing and polishing, or finishing and grinding chip breakers.

ARTER GRINDING MACHINE CO.

WORCESTER 5, MASS.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-106

The table may be set in three positions, relative to the grinding wheel face, to compensate for wheel wear. A milled slot on the table permits use of a protractor—supplied as an extra accessory—for angular grinding. Literature available. T-3-1061

Heavy-Duty Cutters

Introduced by Weddell Tools Inc., Rochester 11, N.Y., is the Series "70" heavy-duty Milling Cutters featuring truncated triangular blades with close spacing afforded without loss of either body or blade strength. Since the blades nest into broached holes, there are no open slots to spring or tear open.



Also incorporated is a novel wedge-type lock which permits locking and unlocking the blades with a quarter to a half turn of a wrench at normal hand pressure. The locking unit is self-contained and the wedge is actuated to and fro without use of hammers or drifts. Each blade is backed by a heavy, fine-pitch screw which permits infinite adjustment throughout the life of the blade. The cutters are available with blades of HSS, super HSS, cast alloy and carbide tipped. T-3-1062

Trigger Stops

A standardized line of Trigger Stops for progressive dies, introduced by Reid Tool Supply Co., 709 Baker St., Muskegon Heights, Mich., are now available 3½, 4, 4½ and 5 in. lengths. The body is 5/16 in. square, the stop end is 5/8 in. long and has a 5/32 in. radius.

Made of cold finished steel and black penetrate finished, the stops are furnished soft for drilling in the location desired for installation in the die. Standardized accessories, their use implies economy over making them separately for each die. Complete details and prices from the manufacturer.

T-3-1063

Micro-Fog Lubricator

Announced by the C. A. Norgren Co., 222 Santa Fe Drive, Denver 9, Col., is the Micro-Fog Lubricator which, like previous Norgren designs, employs the oil fog principle of air-line lubrication.

In this design, however, the fog can be carried to far greater distances and can further be uniformly distributed through several outlets to effect a more thorough lubrication. In addition, air flow requirements are reduced, the while it provides precision control of oil flow. Nor does the unit require special lubricants.



Since metering is said to be controllable to as low as one drop in 20 minutes, the unit produces what may be termed as a "dry fog" that obviates any oil drops ever entering the line. Eight models are currently available in $\frac{1}{4}$ and $\frac{1}{2}$ in. pipe size, and in two sizes of bowl capacity— $\frac{1}{8}$ and $\frac{1}{2}$ pint.

T-3-1071

Annealing Spider

Designed for annealing of wire, an Annealing Spider by KIF Industrial Fabricators, North Haven, Conn., incorporates a construction principle that, effecting even distribution of heat and cooling forces, prevents warping during the annealing process. As contrasted to conventional cross-member constructions, the spider embodies a large central pipe with 8 smaller pipes welded to its periphery.

Claimed by the manufacturer is that the spider facilitates loading of wire coils and further eliminates the costly discarding of spiders due to warpage or because they are too difficult to load or strip. The KIF Spiders are 81 in. high and diameters can be furnished with a range 10 to 30 in. to suit individual needs.

T-3-1072

Double-Step Ladder

A portable Staging, by the Bally-



more Co., 139 Pennsylvania Ave., Wayne Pa., is primarily designed for use with large assembly jobs and in stock room aisles. Incorporating ladder steps on both ends, two or more workers can use the staging at one time. When not in use, it rolls easily on spring mounted swivel casters; however, the weight of one person deflects the casters so that rubber-tipped legs contact the floor.

Made of welded tubular steel, the unit is 30 in. high, 17 $\frac{1}{2}$ in. wide and 48 in. deep. The platform has a 20 in. expanded steel tread.

T-3-1073

Meeting the Needs of Industry for More than 60 YEARS!



Back in 1888, Kemp Smith was a byword for America's supremacy in milling machines . . . pioneering and perfecting many new machines vital to industry. Today, Kemp Smith's matured experience continues to loom soundly on the industrial horizon. You see it in the —

New

KEMPSMITH LH MILLER

— a rugged, yet lightweight milling machine, designed by Kemp Smith Engineers for the many "in between" milling jobs. It bridges the gap between low range hand millers and big, expensive machines . . . combines sound, rigid construction with flexibility and versatility. It's ideal for small end milling, high speed jig boring, keywaying, oil grooving, light straddle milling, etc. Ask for Bulletin No. 127.

KEMPSMITH MACHINE CO.

1847 S. 71st St., Milwaukee 14, Wis., U.S.A.

KEMPSMITH

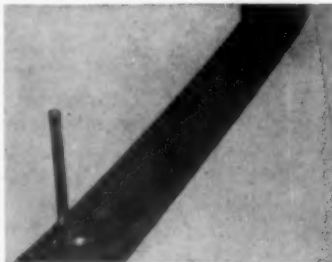
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All America is adopting **HARD-N-TUFF** The Amazing **NEW** Steel Hardening Compound That Gives Mild Steel the Properties of High Grade **INCREASES TOOL LIFE AT LEAST 300%**

Any plant, Large or Small, can use it without special equipment . . .

HARD-N-TUFF will solve your war steel shortages and priority problems. With **HARD-N-TUFF** you can use **CHEAPER** steels and get fine steel performance. Keep drills, cutters, chisels, tools sharper, longer. Keep machines operating longer, faster. Cut machine shut-downs for cutting edge replacements to an unbelievable minimum. Used successfully on all types of tools, parts, dies and other low carbon or high speed materials.



1/4" STEEL DRILL MADE "HARD-N-TUFF"

Drill shown is an ordinary 1/4" carbon steel drill treated with **HARD-N-TUFF**. The hole was drilled dry at lowest speed on press in the automobile spring eye leaf. Cutting time less than two minutes each.



HARD-N-TUFF INCREASED LIFE OF SPECIAL FORMING DIE FOR PIPEWRENCH

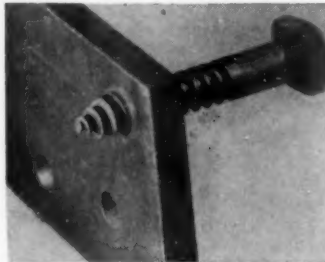
The holes and contour of yoke were die-cut from 4130 chrome alloy steel, 1/8" sheet, while flat. Top face of female section (A), was hardened with **HARD-N-TUFF**. Operation of male die (B), is to bend die cut sheet into form illustrated, (C). Guide pins in (A), were also hardened. Die life was increased by minimum of 300% with substantial savings in spoiled parts and lost manhours.

In simple powder form, **HARD-N-TUFF** is extremely easy to use. Merely heat surface to be hardened, dip or roll in **HARD-N-TUFF**, reheat and quench. Entire operation only a few minutes. Tested on 1020 carbon steel, produces minimum hardness of 60 Rockwell. **HARD-N-TUFF** is the only **CERTIFIED** steel hardening compound on the market.

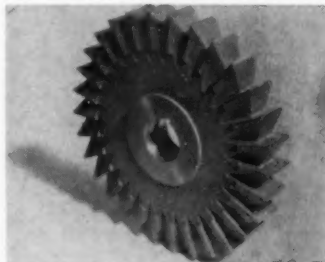
HARD-N-TUFF

DOUGHTY LABORATORIES, INC. 299 Madison Ave., New York 17, N.Y.

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STRENGTH AND ENDURANCE ADDED TO SCREWS AND SET-SCREWS WITH HARD-N-TUFF
Three holes, each the size of the core of the lag bolt (minus threads), were drilled in 1/2" steel plate. The bolt was hardened with **HARD-N-TUFF** and forced through each hole with 12" wrench. Threads cut by bolt were uniform and reusable. Bolt threads undamaged.

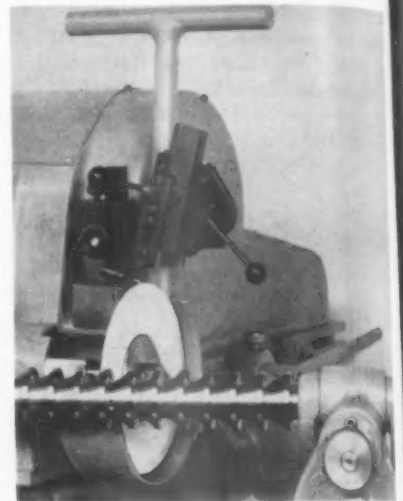


HARD-N-TUFF INCREASED LIFE OF MILLING CUTTER

Carbon steel milling cutter could be run at only 25% of normal machine speed. When hardened with **HARD-N-TUFF**, Emmerich Machine Co. reported that machine was stepped up to normal speed and lost machine and manhours were entirely eliminated.

Dressing Attachment

A grinding wheel dresser for use on broach sharpeners—the Dymon-size Dresser—is now available from Colonial Broach Company. Originally developed to permit grinding of new broaches to higher finishes in the company's plant, the unit consists of an adjustable mechanism designed to produce a fine finish on both the radius and sides of a broach grinding wheel.



Linkage, which covers the arc of travel of the diamond point in the standard Dymon-size dresser, is such that any radius ranging up to 5/16 in. can be readily dressed by a single adjustment. The unit has two control handles—one for dressing radii, the other for dressing the side of the wheel tangent to the radius.

According to Colonial, the finer finish imparted to the broach teeth naturally improves the surface finish on the surfaces machined, the whole apparently traceable to the reduction of "tool marks" on the cutting edges. Smoother chip flow in curling up in the chip space is among other characteristics traceable to improved grinding. Full information on this interesting development may be had from Colonial Broach Company, Box 37, Harper Station, Detroit 13, Mich. **T-3-1081**

Ceramic Flats

Custom made optically flat discs and plates of ASLIMag technical ceramics in any size up to 9 in. diameter are now available from American Lava Corp., Chattanooga 5, Tenn.

Hard and permanently rigid, this product is said to be resistant to all alkalies and acids except hydrofluoric, and to heat shock. They may therefore be used at elevated temperatures. Claimed is dimensional accuracy within practically any specified limits, with larger pieces said to be flat within two light bands. **T-3-1082**

Relief Grinder

D-S Grinder Division of Royal Oak Tool and Machine Company, 623 E. Fourth St., Royal Oak, Mich., announces a motorized D-S radial relief Grinding Fixture featuring a stepless speed control. This is achieved with a selenium rectifier which makes possible speeds from 0 to 80 rpm by simply turning a dial knob.



The motor used is a DC, 110 volt, gear reduction type offering 40:1 ratio. The fixture, which can be used with a number of standard tool grinders, is offered with or without the D-S stand and grinder.

This is the second motorized type unit made available by D-S. The other, which is still offered, is a 3-speed pulley drive with AC motor. The manually operated D-S fixture, first in the line, is also still available where a smaller volume of work is done.

T-3-1091

Die Casting Machine

The A.B.C. Die Casting Machine Co., 339 W. 112th Place, Chicago 28, Ill., has announced an air-operated zinc die casting machine with completely automatic cycling and adjustable timing dwell on the opening and closing of the toggle and injection of the molten metal. The machine, designed to produce castings up to 1 lb., is equipped with a 200 lb. pot and is said to be capable of a free cycling speed beyond 1000 shots per hour.

Utilizing die blocks from 1 1/4 x 8 x 10 in., with an allowable increase in die thickness up to 3 in., the machine incorporates a powerful toggle arrangement to insure relatively flash free castings.

T-3-1092



Thread Chasers



A Thread Chaser developed by O. J. Fairbanks, greater New York chapter, ASTE, is designed to replace cutting teeth of present thread chasers the while it is said to be more resistant to shock.

Claim for these chasers is a threading speed of 150 feet per minute—1200 rpm spindle speed—for cutting a 1/2-20 thread on an alloy steel screw, tolerances held to class 3 fit. Speeds up to 300 fpm are said to be practical but subject to horsepower limitations. Manufactured by the E. J. Deegan Mfg. Co., 725 East 135th St., New York 54, N. Y.

T-3-1093

Why A·B·C Bushings

Last as much as 10% Longer

Since the inception of this business, we have used only steel containing chromium and/or tungsten • That's why A·B·C Bushings deliver as much as 10% longer service than the average • When a supplier decides to "up" the quality of his steel, it may be a couple of years before his customers get the benefit of the change, their orders in the meantime being filled from stock or blanks antedating the improvement • With A·B·C Bushings, steel of chromium and/or tungsten content is no recent innovation. They've always been made from this superior grade steel • That's why it is always good business to specify A·B·C.



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World Problems Hinge on Production, Unity, Politics

Baltimore, Md.—Three angles of the world crisis were pointed up by speakers at the January 3 meeting of Baltimore chapter.

How the Society, its individual members and officers will figure in the tremendous job of national rearmament was emphasized by H. L. Tigges, ASTE president, in an address, "The Tool Engineer and National Defense." The Society's chief executive also touched

on plans the organization has under way.

Sergeants J. M. Brink and George Rozansky of Fort Meade presented a film, "The First 40 Days," showing the devastating results of combat between United Nations and North Korean forces during the crucial opening weeks of the Korean war. This, plus Sergeant Brink's account of his assignment with the Medical Corps, his subsequent

wounds and return to Washington for hospitalization, argued the urgency of a unified and militarily strong United States.

British goals and ambitions in the successful application of the Colombo Plan were outlined by S. C. Bryant, commercial officer of the British consulate in Baltimore. The plan, as described by Mr. Bryant, is aimed at raising the standards of living of the peoples of the Malay Peninsula and neighboring countries not under Soviet domination.

R. D. Brickett, chapter chairman, introduced the speakers and conducted an election for Nominating Committee. J. A. Antonelli, A. J. Jones and T. F. Burke, were named to this committee.

At the close of the meeting refreshments were served to the approximately 50 members and guests present.

Institute Honors Gross On Dean's Retirement

Philadelphia, Pa.—Dean Howard W. Gross, a former chairman of Philadelphia chapter and member of the Scholarship Committee, recently retired from active service at Spring Garden Institute after completing 50 years with the century-old school.



H. W. Gross

A parting dinner, one of two affairs given by the institute in honor of the dean, was attended by a delegation of ASTE members in addition to several prominent Philadelphians and educators. The recent sudden passing of Mrs. Gross lent a note of sadness to the function.

In a touching valedictory Dean Gross offered his services as counselor to the institute in his retirement.

Societies Sponsor Third Local Industry Night

Poughkeepsie, N. Y.—Mid-Hudson chapters of ASTE and the American Society for Quality Control observed Western Printing and Lithographing Co. night, January 15. It was the third of a series of joint annual meetings starring area industries.

Prior to dinner at the Nelson House, approximately 130 members and guests of the two societies assembled at the Western plant to inspect this new and modern factory. The processing of books and playing cards through various stages was described by guides and demonstrated by men and machines in action.

O. H. Somers, quality control engineer at Western, was the technical

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There's no slipping, no damaged drill shanks—the grip is always tight and true. Yet only a slight twist of the chuck body is needed to release the drill.

You need a chuck that's tops in simplicity and design. Save time! Save money! Ask your Industrial Distributor for the new Ettco-Emrick Keyless Drill Chucks and Shanks.

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Fully described in bulletin #7.

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speaker. He cited the value of quality control records and investigations as related to modern production and as a basis for management discussions. His talk was supplemented with blackboard diagrams.

Coffee speaker was Harold D. Spencer, vice-president and general manager of the company. Ownership and profit-sharing policies have been largely responsible for his firm's rapid growth, according to Mr. Spencer.

During a business session, Llewellyn H. Tenney, Walter Stadler and Joseph L. Petz were elected members of the ASTE Nominating Committee.

Ellis W. Thorp, ASTE chairman, presided and introduced the speakers.

Personnel Expert Speaks At Past Chairman Night

Rockford, Ill.—“What Is Your Washroom Rating?” This pertinent question was the subject Edward McFaul, personnel management and advertising expert, brought before some 350 men attending Rockford chapter's annual past chairman's night. The meeting was held January 11 at the Woodward Governor plant auditorium.

Since a supervisor is constantly watched by workers under his direction, he should be governed accordingly even when away from the plant, Mr. McFaul emphasized.

A film, “God of the Atom,” produced by the Moody Institute of Science, also was presented.

Hydraulic Presses Form Giant Pipe from Plate

Kansas City, Mo.—A slide-illustrated description of the processing of 36 in. diameter steel pipe from $\frac{1}{2}$ in. plate 40 feet long highlighted the technical session at Kansas City chapter's meeting in Roselli's Restaurant, January 3. Two presses of 18,000 tons capacity each were built for this work, F. E. Sebring, sales manager, The Hydraulic Press Mfg. Co., Mt. Gilead, Ohio, explained to 60 tool engineers and guests.

Other applications of the open rod and closed upright types of Fastraverse presses were shown by Mr. Sebring assisted by William Truska, Jr. of the same company. These included the drawing and forming of motorcycle fenders at a rate more than triple previous methods involving seven rolling operations.

Another interesting example was the drawing of three flared pans at one time from 29-gage steel. Wrinkles, due to nesting of blanks and taper in draw, were eliminated in a spinning operation.

Mr. Sebring also detailed the use of preplasticizing units on standard injection molding machines. Advantages,



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The Kodak Contour Projector, Model 2, has unique features that permit efficient staging fixtures to keep inspection costs low and inspection standards high.

There's a full eight inches between lens and object, unchanging for any of six quickly dialed magnifications up to 100X—all comfortably visible in a lighted room on an uncurtained 14" screen. You can put the object in any of five planes: vertical, horizontal downward, at left of lens, at right, or atop a glass table. And, just by flipping a switch, you get illumination through the projection lens itself to show surface detail and explore deep recesses.

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shows contours, of course...
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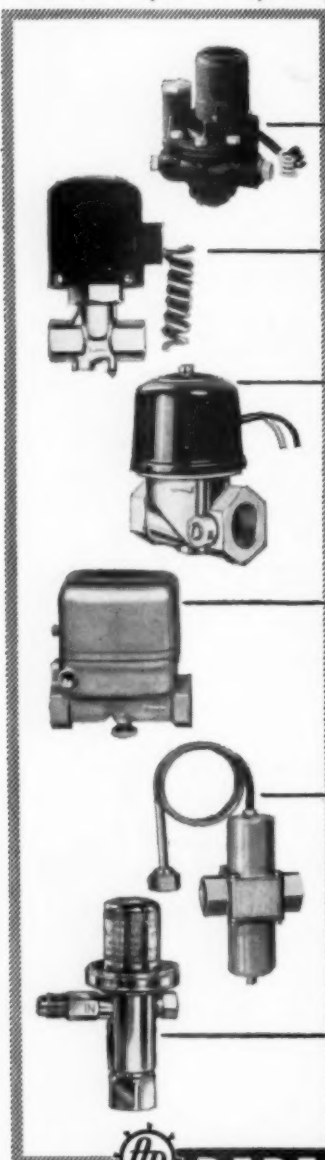
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A-P offers a wide variety of valves adaptable to temperature, pressure or electric control. Years of experience, unexcelled engineering and production facilities, close quality control and meticulous testing guarantee unusual dependability of operation and performance.



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Multi-purpose solenoid valve. Handles air, water, or non-corrosive liquids and gases. Capacity up to 600 gal. per hr.

Rugged, long-life solenoid valve for low pressure air or gas control. Positive opening and seal-off, even with voltage or pressure variations. No sticking or gumming. Quiet, no-hum operation due to unique design.

SILENT, POSITIVE-OPERATION THERMO-ELECTRIC GAS VALVES

Where inexpensive, reliable automatic temperature control is required, this thermo-electric gas valve has many advantages. Its diaphragm-operated power element is absolutely silent in operation. Positive, tight seal-off; full opening, full closing on 30-second cycle. Large capacity; compact size; dependable functioning.

PRESSURE-REGULATED WATER VALVES

A-P water valves will control water flow in response to pressure changes. Unique valve design permits trouble-free operation even in very dirty water. Operating pressure adjustable from 65 to 300 p.s.i. Maximum water pressure 150 p.s.i. 3/8", 1/2", and 3/4" sizes; capacities from 3 to 42 gal. per min.

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he said, are low injection pressure with resulting closer control of dimensions, and savings of material.

Credits Jet Production To Surface Broaching

Richmond, Ind.—Modern jet engine production would be impossible without the development of surface broaching, James Dopp of the Lapointe Machine Tool Co. told Richmond members at their January 9 meeting.

Mr. Dopp presented films on surface broaching, tooling for jet production, and jet propulsion.

J. W. Johnson was elected chairman of the Nominating Committee. Lowell Penland and J. E. Prifogle also were elected to the committee.

Mervin Culbertson, chairman, had charge of the meeting. Dezell Gibbs, program chairman, introduced the speaker.

Out-of-town guests included Fred Allen, L. R. Ware, J. N. Danany and Howard Pond.

The meeting was preceded by a dinner attended by 43 men.

ASTE-ASM Hold Educational Meeting

Worcester, Mass.—The Worcester chapters of ASTE and ASM met jointly January 10 at Worcester Polytechnic Institute, in connection with an educational course sponsored by the ASM group. Dinner was served in Sanford Riley Hall and the technical session took place in Alden Memorial Hall.

Carroll L. Morse, chairman, presided at the ASTE business meeting. John Hayes and Past Chairmen Carl D. Schofield and Charles W. Monigle were elected to nominate a new slate of officers.

Bruce B. Warner, vice-president and general manager of the New England Plating Co., Worcester, was the technical speaker. His subject, "Surface Protection of Metals," was presented to an audience of some 200 members of the two organizations, in addition to a group of WPI students.

Announcement was made of two members added to the ASTE roster during the previous month. They are Merrifield Woodis of the Woodis Industrial Supply Co. and Edmond C. Cloutier of the Brookfield Machine & Tool Co.

Cites Deciding Factors In Machine Selection

Chicago, Ill.—Prime labor costs, overhead, and depreciation of plant and equipment are major considerations in determining types and number of machines to be used, according to E. P. Fluskey, chief engineer of Chicago Screw Co., Bellwood, Ill. Mr. Fluskey

listed these factors while lecturing on "Cost Reduction and the Automatic Screw Machine" at a recent Chicago chapter meeting.

The speaker described methods of determining the point at which work should be done on the automatic screw machine as opposed to the manual type. He explained how to decide on the number of spindles to use in producing a given quantity of a particular part.

Marshall A. Blu, chairman of the 1952 Exposition Committee, reported progress and plans of his committee. F. J. Schmitt, national director, reviewed the semi-annual board meeting at Detroit.

Hagle Elected Chairman Of Nominating Committee

Erie, Pa.—Harold Hagle was elected chairman of the Nominating Committee during a dinner meeting of Erie chapter, January 9, at Mozdy's Hall.

W. L. Kennicott, chief engineer of Kennametal, Inc., Latrobe, Pa., was the technical speaker. He discussed "Design Factors of Carbide Single-Point Tools," using slide illustrations.

S. S. Sadoski, chapter chairman, presided and introduced the speaker and the following guests: Willard Fawcett, Latrobe, Pa., William Herd, and 10 students from Penn State College with their instructor, W. T. Frier.

The meeting was arranged by a committee directed by George Pease.

Gives Diamond Tool Talk

Washington, D. C.—January meeting of Potomac chapter, held at George Washington University, was devoted to a discussion of industrial diamond tools by H. L. Strauss, Jr. of the National Diamond Laboratory, New York.

Mr. Strauss' talk, as given before other chapters, has been reported in previous issues of *ASTE News*.

During the meeting Lawrence Didszonceit, H. Winslow Brown and Robert Plitt were elected a nominating committee.

Williamsport Ladies Entertained at Dinner

Williamsport, Pa. — Approximately 30 couples attended Williamsport chapter's annual ladies night, held January 8 at Ashurst Manor in Muncy.

Chairman William Belknap presided over a short business meeting, when a nominating committee was chosen to submit candidates for officers.

The gathering participated in group singing led by William McCoy. Mrs. Charles Clokey provided dinner music.

William Paul presented films of the scenic Fallbrook trip conducted through the Grand Canyon of Pennsylvania to Watkins Glen, N. Y.



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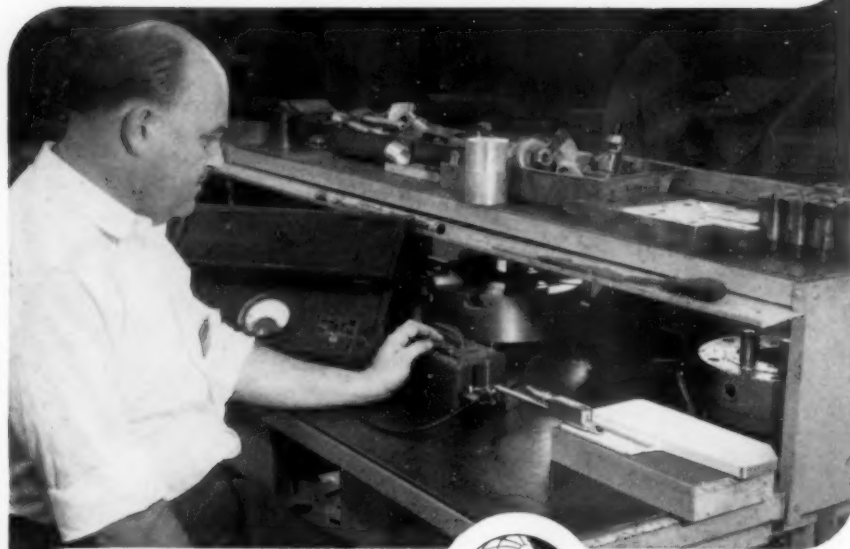
* Cup point for most applications. Cone, flat, half dog and oval points are standard Allen points available from stock for special requirements.



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Coming Meetings

ALL CHAPTERS—March. Installation of officers.

(BRIDGEPORT, CONN.) FAIRFIELD—March 7, Stratford Hotel. Speaker: W. L. Hardy, Norton Co. Subject: "Tool and Production Grinding." H. E. Conrad, ASTE executive secretary, will be guest. April 4, Pitney-Bowes Co., Stamford. Speaker: J. W. Dopp, supervising engineer, Lapointe Machine Tool Co. Subject: "Application of Broaching Machines to Jet Engine Production."

CEDAR RAPIDS—March 21, 6:30 p.m., Montrose Hotel. Speaker: Prof. H. T. Amrine, Purdue University. Subject: "More Production Through Motion Study."

CHICAGO—March 17-21, 1952, Tool Engineers Industrial Exposition.

CLEVELAND—March 14. Speaker: Harry Hyrider, The Vascoloy Ramet Corp. Subject: "Tungsten Carbide and Cast Alloy Wear Parts."

DETROIT—March 8, Ladies Night, Engineering Society of Detroit. Dinner 6:15 p.m. April 12. Plant tour. Student Section: March 15, 7:30 p.m., Junior Room. Subject: "Alloy Steel." April 19. Plant tour.

(FLINT) SAGINAW VALLEY—March 15. Past Chairman's Night. April 19. Plant Tour Fisher Body No. 1 Press and Assembly.

HARTFORD—March 5, 8:15 p.m., Hartford Gas Co. Auditorium. Joint meeting with Society of Carbide Engineers. Speaker: C. R. Morgan, General Electric Co. Subject: "Applications for Carbide in Automatic Screw Machines." March 19, 8:00 p.m. Panel on "Holding Devices."

LOS ANGELES—March 8. Speaker: E. P. Leeds, Brown & Sharpe Co. Subject: "Efficient Milling."

(NEWARK) NORTHERN NEW JERSEY—March 13. Executives Night, dedicated to Hyatt Roller Bearing Co. Speaker from Hyatt.

NEW HAVEN—March 8. Subject: "Molding Plastics." April 12. Plant tour, Sargent & Co.

NEW YORK GREATER—March 14-17, Hotel New Yorker. Nineteenth Annual Meeting, ASTE. March 14, house of delegates and board of directors meet. March 17-22. Post-convention cruise to Bermuda on "Queen of Bermuda." Stay at Princess Hotel, Hamilton, Bermuda.

NORTH TEXAS—March 30, Executives Night. Speaker: Dr. H. B. Osborn, Jr., Tocco Div., Ohio Crankshaft Co. Subject: "High Frequency Induction Heat-Treating."

PHILADELPHIA—March 15, Engineers Club. Gear Finishing Symposium.



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Speakers from National Tool Co. and Michigan Tool Co. April 19. Speaker: Albert Lee, Almco Co. Subject: "Deburring."

(SPRINGFIELD, VT.) TWIN STATES—March 14, Springfield. Speaker: Guy Hubbard, machine tool editor of *Steel*. Subject: "History of Machine Tool Industry." April 11, Windsor House, Windsor. Speaker: G. H. Stimson, Greenfield Tap & Die Corp. Subject: "Unified Screw Threads."

TORONTO—March 7, 7:30 p.m., Oak Room, Union Station. Speaker: Edward Barker, Modern Tool Works, Ltd. Subject: "Duplicating Technique." April 4. Speaker: Prof. E. A. Allcut, University of Toronto. Subject: "Gas Turbines in Industry." April 6, Royal York Hotel. Ladies Night.

(WASHINGTON, D. C.) POTOMAC—March 8, Dodge Hotel. Speaker: B. A. Taylor, vice-president, Chrome Electro-Forming Co., Detroit. Subject: "Hard Chrome Plating to Size." April 5. Speaker: R. E. Coleman, distributor for Pivot Punch and Die Corp., North Tonawanda, N. Y. Subject: "Pivot Punches, Their Use and Application."

WORCESTER—March 6. Visitation, Uxbridge Worsted Mills, Uxbridge, Mass. Dinner at Uxbridge Inn. April 3, Putnam & Thurston's. Speaker: A. N. Kugler, technical engineer, Air Reduction Sales Co. Subject: "Inert-Gas Arc Welding."

(YORK) CENTRAL PENNSYLVANIA—March 5. Speaker: N. M. Perris, management engineer, Stevenson, Jordan & Harrison, Inc. Subject: "Manufacturing Control." April 2. Speaker: C. A. Reimschuessel, chief development engineer, Landis Machine Co. Subject: "Use and Application of Thread Generating Processes."

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INDICATE A-3-115-2

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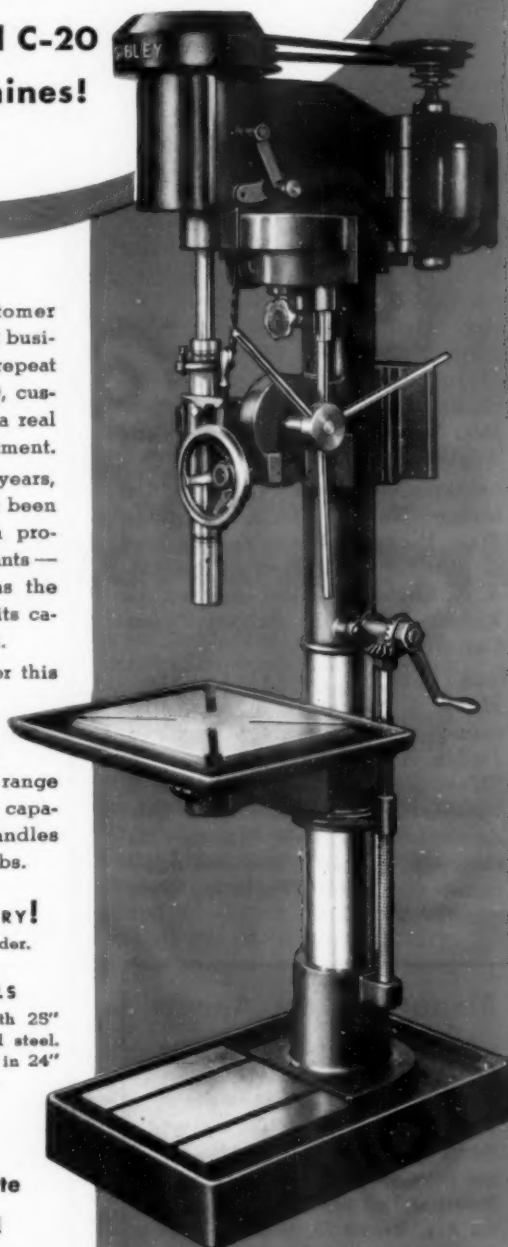
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Technical Shorts ...

An unusual method of forming and drawing sheet metal parts has been developed at Convair's Fort Worth division as a result of several years' testing and improving.

Requiring only a punch and a pressure pad as tooling, the method supposedly eliminates costly die sets and similar die member necessary as conventional tooling.

The punch and pressure pad are mounted on the lower surface of a hydraulic press while a pad of extremely tough rubber on the upper surface of the press serves as the female die.

Metal to be formed is placed atop the punch and pressure pad, and the press is then raised until the metal is pressed against the rubber pad. As the metal is confined against the rubber, and the pressure builds up, the rubber forces the metal down and around the pattern in exactly the required form. The pressure pad controls the shrinking of the material during the operation.

Because rubber acts as the female die in this "Hidraw" process, it is claimed that any thickness of material can be drawn on the same set of tools.

Convair is now offering to license other companies to use its rights to the Hidraw process.

Awards of post-graduate and post-doctoral fellowships to 47 universities and grants-in-aid to 10 universities to "stock-pile" knowledge through the advancement of fundamental research, and to help maintain the flow of technically trained men and women into teaching and research work at universities and into technical positions in industry was recently announced by the DuPont Company for the 1951-52 academic year.

The plan, which started in 1918 as an encouragement for graduate study in chemistry, has since been expanded to include other fields. The 72 post-graduate fellowships include awards in chemical engineering, mechanical engineering, physics, metallurgy, biochemistry and biology.

The grants-in-aid to universities are for unrestricted use in the field of fundamental chemical research.

The universities themselves select the research projects for which the grants will be used, the only stipulation being that they be free from any commercial

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implications at the time the work is initiated. The company also has stipulated that there shall be complete freedom in the communication and publication of the results of the research work supported by the grants.

A recently introduced welding process consisting of methods, procedures and equipment developed and patented by The Lincoln Electric Company, reportedly overcomes previous difficulties of directing the electrode and retaining flux and molten metal in a joint not lying flat.

Automatic hidden arc welding formerly was limited in application to jobs where the joint to be welded was in position for downhand welding. With this "3 o'clock" process, the plate being welded may be positioned anywhere from flat to vertical, the joint being horizontal.

Because the joints can be positioned horizontally, welds from both sides of the joint can be made simultaneously. This not only expands the possibilities for application of hidden arc techniques but also reduces actual arc time on a given joint and thus reduces labor costs as well. Elimination of need for positioning each weld for downhand welding reduces handling and set-up time.

The American Society for Metals offers a 30-minute recording of "Your Career in Metallurgy" aimed at clarifying metallurgy in the minds of those entering that phase of engineering. Swiftly moving, covers series of facts from the ancient hammering-out of metal forms to the sound of a supersonic jet plane.

Available from the society, headquarters, 730 Euclid Ave., Cleveland 3.

"The Oxy-Acetylene Flame—Master of Metals," a 20-minute color motion picture on oxy-acetylene welding and cutting, explains what the processes are and what they will do. Scenes in the foundry and fabricating plant show how the processes are used to cut risers on castings, produce welded aluminum frames, prepare H and I beams for heavy construction.

Through animation the workings of welding torches, cutting torches and oxygen and acetylene regulators.

Information on the film is available from the secretary of The International Acetylene Association, 30 East 42nd St., New York 17.

Metal and Thermit Corporation has announced that it is now producing tin and tin alloy anodes for use in the electroplating of tin and for tin-zinc plating process. Pure tin and high speed alloy tin anodes are available are said to provide increased efficiency in tin plating, while the tin-zinc anodes are offered for use for depositing a tin-zinc alloy.

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North East West South in Industry

From The Whiton Machine Co. comes the announcement of the appointment of **Evan Price** as turbine sales manager. Mr. Price formerly was associated with The Kissick Co. of New York.

Emil R. Schaeffer has been appointed manager of manufacturing of **General Electric Company's** Switch-gear Divisions. Mr. Schaeffer, who joined G.E. in 1919 as a draftsman, has held the positions of tool designer, manufacturing layout supervisor, supervisor of tool planning and wage rates, works superintendent and, in 1948, was named assistant to the manager of manufacturing.

Appointment of several new officers, recently announced by the **Birdsboro Steel Foundry and Machine Co.**, included **Robert F. Rentschler** as vice-president assigned to special duties, **James M. Heppenstall**, as treasurer, and **Lester E. Leinbach**, as secretary of the company. All three men previously held positions carrying similar responsibilities in the firm.

Alex G. McKenna was elected executive vice-president of **Kennametal Inc.** by the board of directors at their recent meeting. At the same time other important personnel changes, brought about by expanded activities, included the naming of **John C. Redmond** as vice-president and **Richard J. Flickinger** as assistant secretary.

Paul Abel has been elected vice-president in charge of engineering for **The Yoder Co.** Mr. Abel has been associated with the company for the past 17 years.



Alex G. McKenna



Paul Abel

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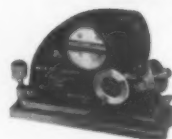
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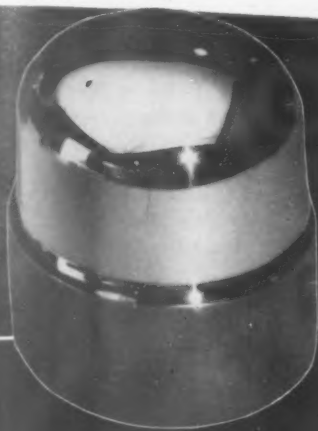
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An electric furnace plant for the manufacture of silicon carbide abrasive has been opened by the **Norton Co.** at Cap-de-la-Madeleine, Quebec. It is expected that the plant, purchased in 1949 from Durham Chemicals (Canada) Ltd. will provide facilities for a 50 percent increase in the manufacture of Norton's Crystolon abrasive.

Election of **Frank W. Jarvis** to the presidency of **Diamond Magnesium Co.** has been announced by the company's board of directors. Mr. Jarvis has resigned as president and a director of the Fairport, Painesville and Eastern Railroad to accept the post. Reactivation of the company is being accelerated due to the national military-preparedness production program.

Robert T. Haslam has been elected to the board of directors of **Worthington Pump and Machinery Corp.** Mr. Haslam formerly was a vice president and director of Standard Oil Co. (N. J.); a director and member of the executive committee of Ethyl Corp., and is a member of the Corporation of Massachusetts Institute of Technology.

Coming Meetings

Mar. 14-17, Nineteenth annual meeting, **American Society of Tool Engineers**; Hotel New Yorker, New York.

Mar. 19-23, Seventh Western Metal Congress and Exposition sponsored by **American Society for Metals** in cooperation with 20 national technical societies; Civic Auditorium and Exposition Hall, Oakland, Calif.

Mar. 19-23, "Conference on Industrial Personnel" on various phases of industrial organization and management, sponsored by **Department of Industrial Engineering, Columbia University**; to be held at the university, New York City.

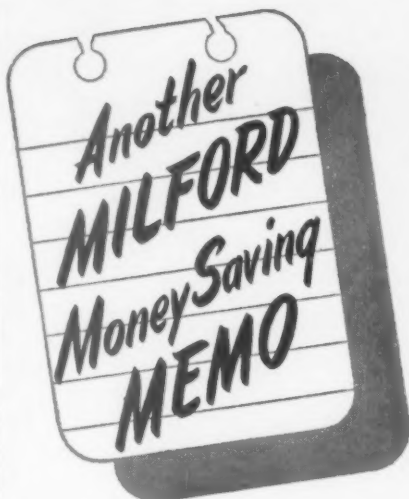
Mar. 28-29, Conference on instrumentation for iron and steel industry, planned by Pittsburgh section of **Instrument Society of America** and the **Carnegie Institute of Technology**; Pittsburgh.

Apr. 16-18, National convention of **American Society of Lubrication Engineers**, held in conjunction with 4th annual Lubrication Show; Bellevue-Stratford Hotel. Philadelphia.

Apr. 23-26, **American Foundrymen's Society**, 55th annual convention; Buffalo.

Apr. 30-May 4, **National Materials Handling Exposition**; *International Amphitheatre*, Chicago.

Apr. 30-May 11, **British Industries Fair**; Castle Bromwich, Birmingham, England.



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Trade Literature

Cylinders, Hydraulic

Catalog No. 200, Section 2, presents complete data relative to the company's recent engineering developments on their "Rotocast" hydraulic cylinders; wide use of photos, engineering drawings and tables illustrate line. Logansport Machine Co., Logansport, Ind.

L-3-1

Cut-Off Wheels

Six-page bulletin No. 6888C lists wheel grade recommendations and cutting performance data as well as operating suggestions for the Delta cut-off machine. Abrasive Wheel Dept., Manhattan Rubber Div., Raybestos-Manhattan, Inc., Passaic, N. J.

L-3-2

Coatings

Properties of more than 100 industrial adhesives, coatings and sealers tabulated in 32-page illustrated catalog, "3M Adhesives, Coatings and Sealers," offering research help for users in selecting right product for the job; Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn.

L-3-3

Universal Joints

Data on selection of universal joints, graphs on static torque tests, angle of operation efficiency curves and on frictional heat loss curves, dynamometer tests, assembly instructions, engineering data and specifications plus buying and ordering instructions and prices, included in catalog C1. Curtis Universal Joint Co., Inc., Springfield 7, Mass.

L-3-4

Steel Bar

Bulletin AM-100 introduces steel bar stock, cold drawn in special sections to fit specific purposes; points out wide range of pre-shaped stock, stressing economies obtained through their use; drawings of some typical pre-shaped steel sections shown and indications given of various analyses in which this specialty stock is available. A. Milne & Co., 745 Washington St., New York 14.

L-3-5

Hose

Revised and more complete edition of The Weatherhead Reusable Steel Hose Ends and Industrial Hose Catalog, H-1451-A, covers additional sizes of hose couplings in medium, medium high and high pressure types; includes complete technical information on their SAE 37 and 45 deg flare adapters. Industrial Sales Div., The Weatherhead Co., 300 E. 131st St., Cleveland 8.

L-3-6

THE TOOL ENGINEER'S *Service Bureau*

TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

LITERATURE NUMBER

COMPANY

BULLETIN

DESCRIPTION

A-3-109	ACCURATE BUSHING CO.		Catalog and other information needed by the tool engineer on A-B-C Bushings.
A-3-16	ALLEGHENY LUDLUM STEEL CORP.		Four page folder, "A-L Mill Treated High Speed Steel Holder Bits."
A-3-96	ARMSTRONG BROTHERS TOOL CO.		Catalog on Armstrong Tool Holders.
A-3-136	THE ATRAX CO.		Catalog on Tungsten Carbide Rotary Files, End Mills, Reamers, Boring Bits, etc.
A-3-141	W. O. BARNES CO., INC.		Literature on Band Saws and Hack Saws.
A-3-92	E. A. BAUMBACH MFG. CO.	Catalog B-50	Catalog on Die Sets.
A-3-133	BAY STATE ABRASIVE PRODUCTS CO.		Descriptive Literature on Abrasive Products.
A-3-137	THE BELLOWES CO.	Bulletin CL-30	Descriptive literature on Air Motors.
A-3-151	CHARLES H. BESLY & CO.		Up-to-date booklet containing authoritative information on modern grinding wheels.
A-3-118	CHICAGO WHEEL & MFG. CO.		Catalog describing mounted abrasive wheels.
A-3-200	THE CINCINNATI SHAPER CO.	Catalog S-5	Complete catalog on Cincinnati's shapers.
A-3-190	THE CLEVELAND TAPPING MACHINE CO.	Guide No. T-3	Production Tapping Guide on Tapping, Threading, Drilling, Spot-facing, etc.
A-3-142	COLONIAL BROACH CO.	BN-1250	Wall or bulletin board poster of DO and DON'T items to help reduce broach maintenance costs.
A-3-149	DELTA POWER TOOL DIVISION, ROCKWELL MFG CO.		"The Power Tool Journal," catalogs, and bulletins on time and money-saving ideas.
A-3-111	EASTMAN KODAK CO.		Booklet on Kodak Contour Projector describes advantages, uses and operations.
A-3-186	THE EASTERN MACHINE SCREW CORP.		Booklet on "Selecting Proper Die Head for the Job."
A-3-118	ENGIS EQUIPMENT CO.	Catalog No. T-351	Comprehensive catalog on inspecting equipment.
A-3-110	ETCO TOOL CO., INC.	Bulletin No. 7	Describes Etco-Emrick Keyless Drill Chucks and Shanks.
A-3-95	GREENLEE BROTHERS & CO.		Literature describing in detail Greenlee Automatics.
A-3-93	HAMMOND MACHINERY BUILDERS		Catalog describing Carbide Grinders.
A-3-30	HANNIFIN CORP.	Bulletin 110	"Hannifin Hydraulic Cylinders."
		Bulletin 210	"Hannifin Pneumatic Cylinders."
A-3-3	HARDINGE BROTHERS, INC.	Bulletins "S" and "B"	Describes Style "S" Sure-Grip Draw-in Master Collets and Pads and Style "B" Master Feed Fingers and Pads.

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A-3-201	JONES & LAMSON MACHINE CO.	Catalog 710	New Chart Catalog which helps to make inspection operations become routine jobs.
A-3-176	KAUFMANN MFG. CO.	Catalog No. 1150	Describes Kaufmann Tapping Machines
A-3-171	KELLER TOOL CO.		Booklet describing "The Hole Story of the Keller Airfeedrill"
A-3-107	KEMPSMITH MACHINE CO.	Bulletin 127	Bulletin describes Kempsmith's LH Miller etc.
A-3-153	THE LAPOINTE MACHINE TOOL CO.	Catalog No. 5	Condensed catalog on single ram verticle broaching machine.
A-3-32	LATROBE ELECTRIC STEEL CO.		Booklet "Why Desegatized" showing superior features of Desegatized Brand steels.
A-3-20	METAL CARBIDES CORP.	Catalog 50-G	Catalog showing 1,325 different sizes of standard solid Tungsten Carbide blanks, bars, strips, rods, tubes, bushings, rings, etc.
A-3-154	THE MOTCH & MERRYWEATHER MACHINERY CO.	Bulletin 250-T	Detailed information on standard line of slitting and slotting blades as well as special blades to order.
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A-3-199	NEW HARMES, INC.	Catalogs R-41, 1M-41	Deals with heavy duty and with portable Engravingraph.
A-3-23	NORTON CO.	Form 835A6	"A Handbook on Tool Room Grinding" about lowering tool room grinding costs.
A-3-124	ORTMAN-MILLER MACHINE CO., INC.		Free Templates showing all cylinder and mounting brackets for Air Hydraulic Water Cylinders.
A-3-163	POPE MACHINERY CORP.		Drawings "A" and "B," showing a wide variety of styles and sizes of Round Frame Cartridge Type Pope Precision Motorized Spindles.
A-3-1	PRATT & WHITNEY		14 bulletins on Cutting Tool Literature.
A-3-156	RIVETT LATHE & GRINDER, INC.	Catalog No. 202	A 52 page catalog illustrating and describing all types of hydraulic valves.
A-3-165	SCULLY-JONES AND CO.	Bulletin No. 8-50	Bulletin showing complete range of sizes, specifications and prices of "JA" Floating Holders.
A-3-103	THE STANDARD ELECTRICAL TOOL CO.	Bulletin 18	Covers company's Twin Wheel Tool Grinders.
A-3-25	THE L. S. STARRETT CO.		New Ground Flat Stock Folder and Wall Chart listing all sizes and giving formulas for both oil and water hardening.
A-3-11	SUNDSTRAND MACHINE TOOL CO.	Bulletins 705	Bulletins describing "Engineered Production" on milling jobs.
A-3-170	TUTHILL PUMP CO.		Bulletin describing company's line of stripped pumps.
A-3-162	THE VAN KEUREN CO.	Catalog and Handbook No. 34	A 208 page handbook representing 2 years of research on measuring and methods.

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Trade Literature

Fluid Power Equipment

Bulletin 10051-A pictures line of fluid power pumps, motors, transmissions, cylinders and valves; accompanying discussions include specification tables and dimensional drawings; features recently introduced or improved lines of equipment covering delivery pumps, motors, cylinders and valves. **The Oil-gear Co.**, W. Pierce St., Milwaukee 4, Wis.

L-3-7

Cutting Tools

Literature regarding the reconditioning of highspeed and carbide cutting tools plus a convenient decimal equivalent card available from **Rutland Tool Service**, 1617 E. McNichols Rd., Detroit 3.

L-3-8

Hardening Steel

Bulletin 13 describes simple procedure for gradient depth hardening of machine parts, cutting and impact tools, wire, hand tools and engraved stamping dies; discusses gradient depth hardening of any kind of steel with a positive change in grain structure from the steels surface through the ductile are and through the core; charts and photos illustrate test results. **Wilson Carbon Co., Inc.**, 60 E. 42nd St., New York 17.

L-3-9

Power Brushes

Four-page booklet describes recently developed line of power brushes; emphasizes main qualities of service; discusses installations; complete instructions for ordering and specifications for use also are included. **The Osborn Manufacturing Co.**, 5401 Hamilton Ave., Cleveland.

L-3-10

Chucks and Cylinders

Cutaway pictures explain various models and photos show equipment at work in illustrated 44-page catalog of power chucks, air cylinders and other equipment; engineering drawings and complete reference tables make the catalog convenient for the draftsman as well as engineer. **The S-P Manufacturing Corp.**, Cleveland.

L-3-11

Pumping Units

Comprehensive pumping unit manual contains information on specifications, performance tables, cut-a-way views and blue prints of various models useful to manufacturers and owners of equipment and machinery requiring coolant pumps or coolant systems. Simplified selection charts give instructions that can be used in selecting proper type unit for best performance. **The Graymills Corp.**, Evanston, Ill.

L-3-12

March, 1951

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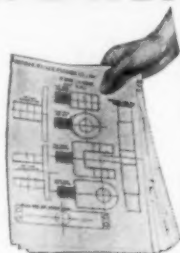
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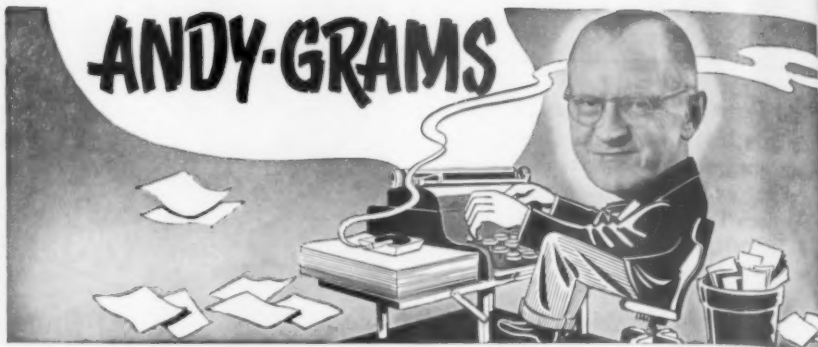
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Ordinarily, I don't like to print personal plugs, and usually delete or prune the bouquets. Since, however, the following letter is a tribute to the entire staff, I'll present it in its near entirety:

Dear Andy:

I have just finished reading the new **TOOL ENGINEER** and through you, wish to congratulate the editors and all others who have had anything to do with the rebirth of our magazine. An excellent medium for the dissemination of technical data and news of interest to our Society.

The subject matter of Andygrams in this (January) issue stirred me deeply. As a matter of fact, I think it is one of the most pertinent and best columns you have ever written, and I want to congratulate you on the sincerity of your convictions and the well thought out continuity of the subject matter.

It is always pleasant to meet you two or three times a year at our **ASTE** conventions, and I am looking forward to that same pleasure at New York, March meeting.

Cordially yours
J. B. (Jack) Savits
Boston Chapter

Well, there's no question but what the larger type in the reborn *The Tool Engineer* makes for easier reading, and this should particularly please my friend Herman Ortegren, who has been asking for larger type these many moons. For my share in the contents, and notably the "Tool Engineering Report", I want to express thanks to the many manufacturers who complied with my requests for photographs; particularly, to Ross MacNaughton and Harry Phillips of Ford Motor Company for photos which we could not credit with a caption.

As for the January *Andygrams*, Jack's letter encourages me to continue with the Column. Usually, I leave that writing as a final chore after all other work is done, then crowding the deadline, go ahead and hope for the best. As a rule, the contents are inspired by occasional contacts with members, letters coming to hand, or some topic that seems timely at the moment of writing.

While at the Ford plant, I heard that Ray Morrissey had left Cross Company and is now manager of manu-

facturing engineering for the Ford Engine & F'dry Div'n. Well, Ray's had a world of experience and progressive to boot, and I don't know which to congratulate the most, Henry Ford II for picking a good man or Ray for moving ahead. Anyway, my regards to both.

Pursuant to "nailing the tea can to the bench", which stirred nostalgic memories in many of our old timers, here's another letter which, while it may take some delicate handling, is too good to pass up.

Dear Andy:

Here is another old timer getting into the "them" days" act. As an apprentice back in '98 I toted hot water for tea, along with other chores delegated to beginners at that period. One of which, during the cold weather, was to go out to the blacksmith shop at 5:30 and see to it that the helpers had heated steel bars and immersed them in the wash trough, so we'd have hot water. You'll have to censor this one. Our "his" room was situated over a pond with the rear (?) opening to the north as you probably know, the winds are brisk in New Jersey Best wishes and remember me to Harry Conrad.

Jack Borrup,
Hartford Chapter

Yessirs, them were the days when a little bit went a long ways, and well I remember them. My first job was in a cotton mill situated on a New England river—the "Big Stink" as we called it—and "it" also overhung the water, staggered outward from main floor to upper stories. However, there were other hazards than the chilly breath of Boreas to preclude leizurely reading of the Sears-Roebuck catalogue. As kids, we used to stand on the opposite bank and snipe at exposed surfaces with BB guns and slingshots. . . . !

When I started to work there I borrowed from experience gained in school, when a piece of cardboard strategically placed cushioned the impact of a rattan switch. So, I came prepared with a tin shield; then, my erstwhile playmates could ping away to heart's content and no casualty suffered.

Once, during my apprentice days, a journeyman blamed me for nailing his rubbers to the floor, which I hadn't

done (to him), and warmed my posterior with a length of drill rod. But, I got even! It so happened that we were making high tension magnetos—among the first ever built in the U.S.A., by the way—and a battery of the mags was usually under test on a stand close to the “throne”. After hours, I drove two copper nails through the seat, filed them flush with the top surface, then connected wires from the test stand to the nail heads. I waited until aforesaid journeyman was comfortably settled, then turned on the entire battery . . . and omigosh!

Reminds me of another one. As an apprentice, my chores were plenty diversified, and one day I had to bring up some pine boards from the yard. I up-ended them in the freight elevator, and as we were on the top floor, where the elevator stopped automatically, I turned around to regard the landscape through the windows. Then, of a sudden—whack!—I got a slap on the stern that catapulted me head first through the window, sash and all, and the next thing I knew I was sitting on a pile of hot ashes the fireman had just brought out from the boiler room. Seems that the upper end of the boards had caught under the third floor door lintel, then, bowing into an arc, finally cracked. No, I wasn't hurt; just burned enough so that, for a few days, I found it more comfortable to stand than to sit.

As I've said before, I'm not one to sigh for the “good old days”, although they provided their moments. Anyway, one can remember funny things that have happened whereas one would have to imagine futures. The friends that we have, and that wear well, are all of the past however the morrow may bring new attachments.

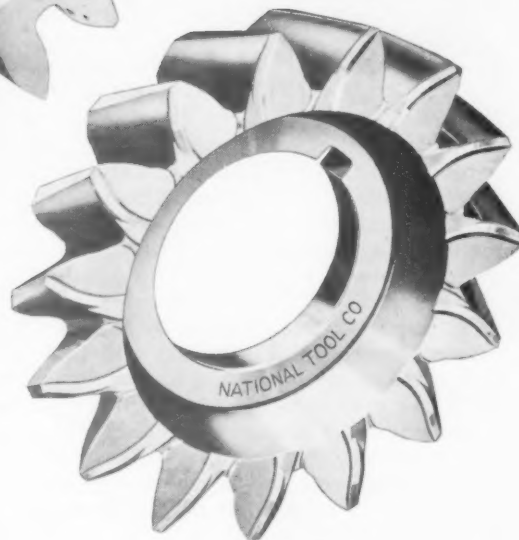
What I particularly remember, and with gratitude, are the many kindnesses extended by the old timers with whom I worked as a youngster. The times were hard, and discipline strict where apprentices were concerned; yet, we enjoyed a freedom denied to apprentices today. For we were encouraged to make our own tools and outside of a kit of which I was quite proud, I had made workable gas and steam engines as well as numerous electric motors and gadgets, all on “government” time. When my time was out I was free to work anywhere where skill and initiative was in demand, and in my travels I cemented friendships that have endured to this day. There are few if any regrets.

ASTEely yours

Andy

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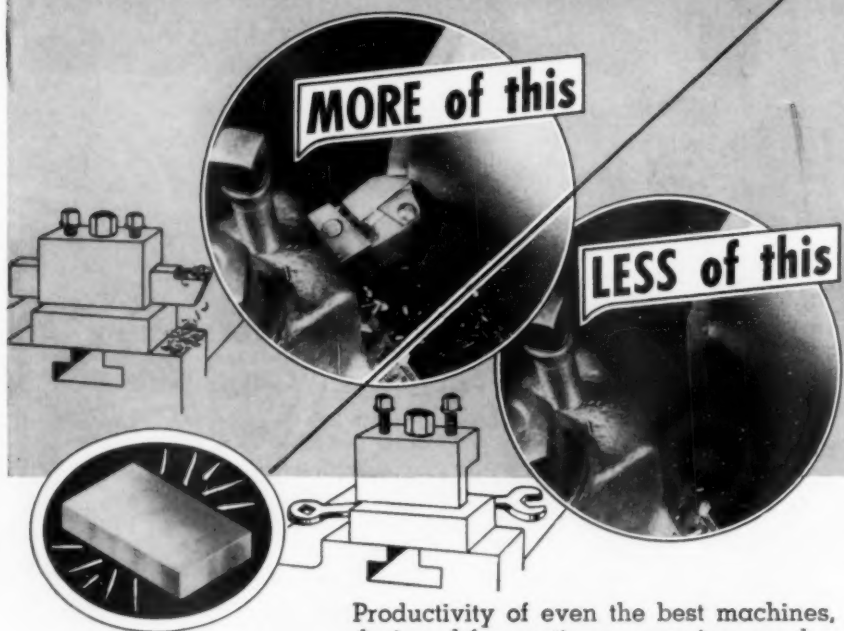
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126

Good Reading A GUIDE TO SIGNIFICANT BOOKS AND PAMPHLETS OF INTEREST TO TOOL ENGINEERS

TOOL ENGINEERING, by Lawrence E. Doyle. Published by Prentice-Hall, Inc., New York, N. Y., 500 pp.; price \$6.35.

The author, who is a registered professional engineer and Asst. Professor of Mechanical Engineering, University of Illinois, has taken an analytical rather than a descriptive approach to his subject; to that end, a work primarily intended as a college course text is also of value and interest to veteran tool engineers.

Treating tool engineering as "an expanding field," the author prefaces his work with a generalized definition of tool engineering, quoting such authorities as Grant S. Wilcox, Jr., O. W. Winter and Prof. O. W. Boston. From there on, he takes the reader through principles and problems of economics; planning and tooling for economy; principles and short cuts estimating; then through fundamentals of processing and design to actual manufacturing techniques.

All told, an exceptionally well rounded work which may be considered as a valuable contribution both to the science and practical application of tool engineering.

THE SELECTION AND HARDENING OF TOOL STEELS, by H. L. Seabright. Published by McGraw-Hill Book Company, New York, N. Y. 263 pp.; price \$5.00.

The author, who is research engineer with Vulcan Stamping & Mfg. Co., has provided a systematic guide to the selection of tool steels in which he gives 960 analysis of steels arranged in terms of their lengths and wear resistance. What is of particular interest, at this time, is the classification of all tool steels produced by companies in the United States and Canada with logical groups based on their properties and performance. The book therefore provides metallurgists, tool engineers and others directly concerned with the performance of tool steels with a quick, easy method of finding a steel particularly suited to their needs.

One can not only look up the properties of any specific tool steel, but may

The Tool Engineer

compare them with other tool steels. Stressing the relationship between steels as they are actually used in industry, the book first classifies tool steels into 12 main groups, then into 40 subgroups or "types" in which the group members are interrelated in terms of their properties and average hardening and tempering speeds.

An interesting section covering the steels in each group permits one not only to readily single out the steel with needed properties, but also to get a general line on all steels in the group. Included is information on heat treating and tempering and, especially, on such heat treating developments as martempering and salt-bath quenching.

BIBLIOGRAPHY OF NON-METALLIC BEARINGS, issued by the Engineering Societies Library, 29 W. 39th St., New York 18, N. Y. Price \$2.00.

This is an annotated bibliography of 101 selected references to the literature of the past 12 years and covers all aspects of non-metallic bearings such as their manufacture, design, properties, wear, lubrication, performance, testing and applications.

Particularly, the matter covers bearings made of rubber, wood, laminated phenolic plastics, resin-impregnated cotton fabric, micarta and nylon. Applications discussed are for rolling mills, marine propeller shafts and rudder posts, automatic presses, axle bearings for railroad rolling stocks and agricultural machinery.

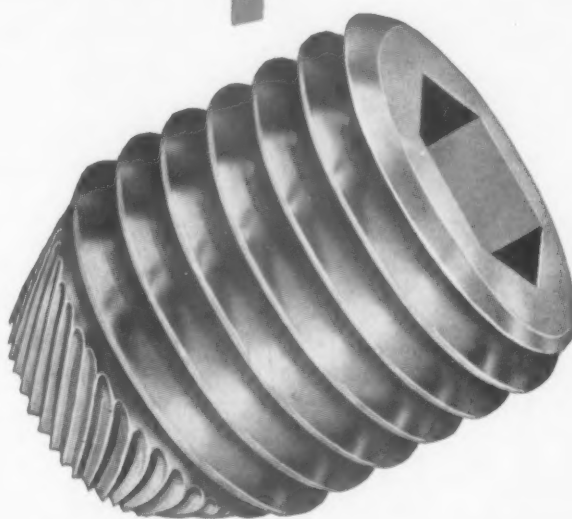
PROCEDURE HANDBOOK of ARC WELDING DESIGN AND PRACTICE. Published by the Lincoln Electric Company, Cleveland, Ohio. Ninth edition, 1200 pp., price \$2.00 in U.S.A., \$2.50 abroad.

Revised and re-edited, this book contains added data and information on the latest welding procedures, the whole making the work more helpful to designers of welded machines and structures. Latest procedures are given for welding all metals and alloys commonly welded with manual open and hidden as well as automatic and semi-automatic hidden arc welding.

The section on structural design has been enlarged and revised to include more information on welded rigid framing; also, the section on machine design has been expanded to include more information on design of machine tools. Added is a chapter on welded design data; this, presenting the fundamentals of welded design for both machinery and structures, includes stress allowances which can be applied to specific design problems.

March, 1951

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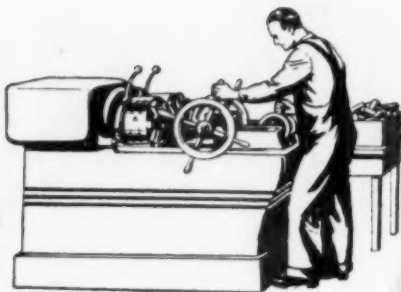
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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-127

TIPS ON TAPPING AND THREADING TROUBLES



Page A-6

OILS FOR TAPPING AND THREADING OILS WITH ACTIVE SULPHUR REQUIRED

Tapping and threading are difficult machining operations due primarily to limited chip room and the difficulty of maintaining sufficient lubrication at points of contact between threading tool and workpiece. Cutting oils having high sulphur activity are usually required and recommended for difficult threading and tapping work. Stuart's THREDKUT and related products, due to their high effective sulphur content, have been outstanding for this class of work. Active or effective sulphur in an oil functions as an anti-weld agent preventing pick-up of metal particles on the tool which results in scuffing and poor finishes.

RULE OF THUMB

Here is a good rule of thumb to remember when sulphurized cutting oils are being used:
When you observe excessive wear on the front clearance of cutting tools, **DECREASE** the amount of active sulphur in the oil by diluting with paraffin oil or other low cost blending oil. If poor finish is encountered due to welding or metal pick-up on the tool edge, **INCREASE** the active sulphur, or if Stuart's THREDKUT is being used, apply it straight.

Operation: Threading male pipe union sections on large automatics using single point tools.
Material: Type 310 stainless steel.

Oil:	Previous Oil	Stuart's THREDKUT 9961
Tool Life:	136 pcs. per tool grind	310 pcs. per tool grind
Part Finish:	Fair	Excellent
Cutting Fluid Costs on Machine:	\$0.47 per gallon	\$0.44 per gallon

Write for Literature and ask
to have a Stuart Representative call

D.A. Stuart Oil Co.

2727-49 S. Troy Street, Chicago 23, Ill.

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Abstracts Of Foreign Technical Literature

By M. Kroenberg

England: "Failures of naval gearing" is the topic of a paper presented by J. H. Joughen of the British Navy before the Institute of Mechanical Engineers as reprinted in "Engineering" of January 5, 1951. After an extensive discussion and comparison of the various processes involved in the manufacturing of gears, such as hobbing, shaving, heat treatment and their effect on oil film clearance, surface finish and undulation, the author indicates that the primary quality required of gears is resistance to fatigue in bending under stress concentration to be found at the root. Another desirable quality is, of course, resistance to pitting and wear.

Since fatigue data on gears are difficult to find, tests have been made by the Admiralty-Vickers Gearing Research Association from which the following conclusions have been drawn:

1. To keep vibration and noise caused by periodic manufacturing errors to a safe limit, the depth of undulation from such errors must not exceed 0.0003 in.
2. To eliminate the risk of pitting, surfaces of the teeth must be kept free from undulations of more than 0.0001 in. range.
3. The effect of pinion deflections in concentrating the load at the outer ends of the helices is often critical, causing tooth fractures.
4. To eliminate breaking and pitting of gears it is recommended, when assembling gear boxes, to measure the parallelism of the shafts and to ascertain the freedom from cross wind-up in the design.

While craftsmanship has long been established in the gold and jewelry trade, the application of tool engineering principles to the many problems concerned with manufacturing methods is of more recent origin.

This trend is indicated in an article published in "Metallurgia" in December 1950, describing a newly-opened

design and research center for the gold, silver and jewelry industries. The great number of reports issued reveals the wide range of problems that have been investigated. Electro-plating and finishing processes figure prominently. Further research was concerned with barrel polishing, electrolytic protection from tarnishing, vacuum evaporation for the embellishment of costume jewelry. Tool engineers may also get new ideas from some borderline topics such as casting of low melting point alloys in rubber molds, melting and casting of nickel-silver ingots, determination of porosity in cast sterling silver by radiography and from similar subjects.

The effect of surface finish on stress corrosion properties of aluminum-magnesium alloys is discussed by S. E. Hadden and E. C. W. Perryman in "Metallurgia," December 1950. Increase in stress corrosion resistance results from treatments which introduce into the surface compressive stresses acting in opposition to tensile stresses.

France: A study on the properties and applications of titanium was published by M. R. Maillet in No. 4/1950 of "Annales des Mines." The low density, great tensile strength and surface hardening properties by nitriding and carburizing render this material very useful for high speed machinery and for supersonic instruments.

M. E. Blanpin discusses French investigations of optimum conditions for the machining of cast steel with carbide tools in the April 1950 issue of "La Machine Moderne."

Germany: American and European metal cutting investigations and data are commented on and summarized in the 2nd edition of "Zerspanung und Werkstoff" (Metal Cutting and Work-material), a book of about 250 pages edited by E. Broedner, and published by W. Giradet, Essen.

The author, quoting articles in *The Tool Engineer*, indicates that the revised edition was influenced by these articles, and particularly agrees with the principle of close cooperation between research and practice in tool engineering as a means for promoting progress in production methods.

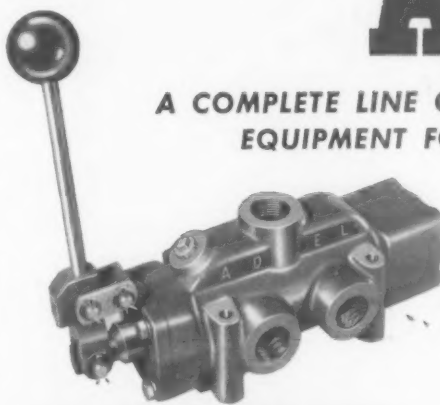
The well-prepared book takes therefore both sides into consideration. It covers all fields of metal cutting namely turning, drilling, grinding, tapping, milling, broaching and reaming, always referring to the scientific and applied aspects, such as cutting forces,

(Continued on page 130)



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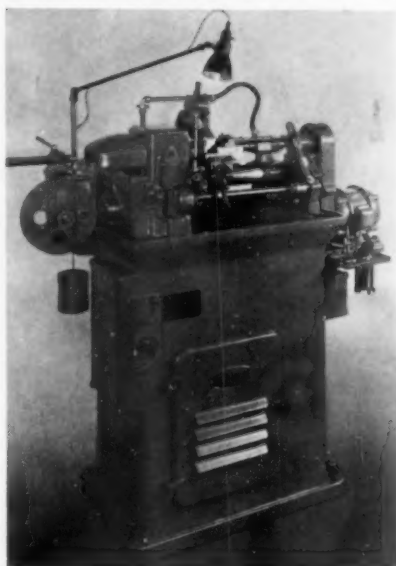
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Abstracts of Foreign Technical Literature

(Continued from page 129)

cutting speeds, tool life, tool design and cutting fluids.

The merit of the book lies in the fact that it includes not only older and newest development in Germany, but consistently takes American methods and research into account, rendering it possible to compare metal cutting on the two continents.

The second part of the book deals with work and tool materials. It will be appreciated by tool engineers and designers desiring comparative information on American and German materials in a single book.

Almost 40 pages are devoted to an international bibliography arranged by main subjects such as negative rake cutting, short-cut methods for testing of cutting force, surface finish and many others.

A new optical instrument for calibration of gages is the subject of an article by R. Schulz published in "Zeitschrift des Vereins Deutscher Ingenieure" of January 11, 1951. This instrument, termed Perfecto-Comparator, has been developed by the Leitz Works in order to eliminate calibrations using mechanical methods which cause rapid wear and therefore inaccuracies in Johansen blocks. The surface to be measured is optically "touched" by the new comparator using the reflex from the highly polished surfaces of the gages. The measuring or reference point can be determined by means of a projected picture of a cross mark. The method is claimed to be 100 percent more accurate than older methods permitting an accuracy of ± 0.000004 in.

H. Bolza describes a new method for computing the financial success or failure of production improvements in an article published in "Zeitschrift des Vereins Deutscher Ingenieure" of January 1, 1951. The author's formulas are simple and can easily be applied to cases where it is desired to ascertain the conditions and combination of wages, cost of material, overhead, production time, etc., which would result in a profit or loss due to a technical improvement. As an example he takes the data covering an entire year in a plant and analyzes all factors that would contribute to continued profit and also those that would have the opposite effect. Border-line cost—a new concept—is found to have an essential effect on the result and therefore on the approval or disapproval of a contemplated project.

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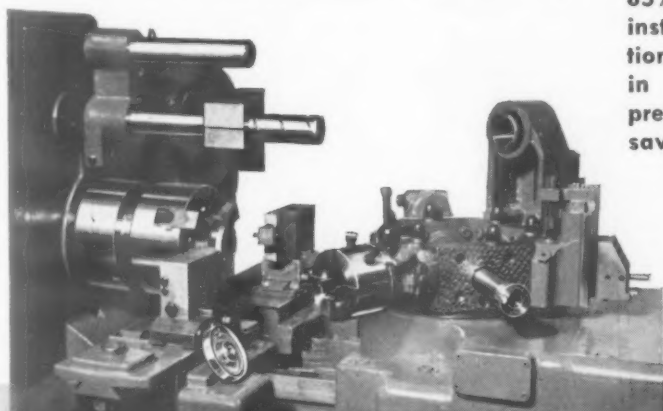


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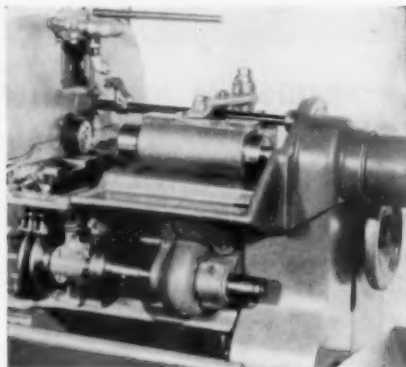
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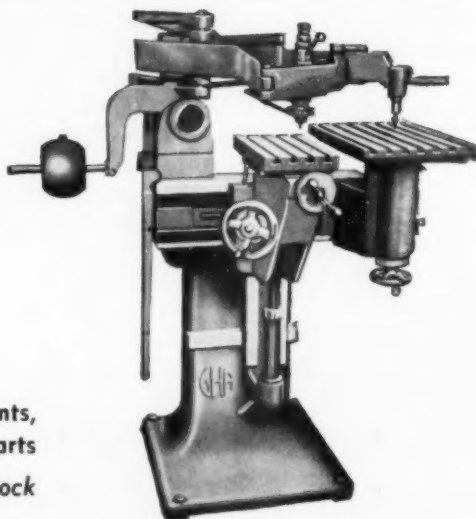
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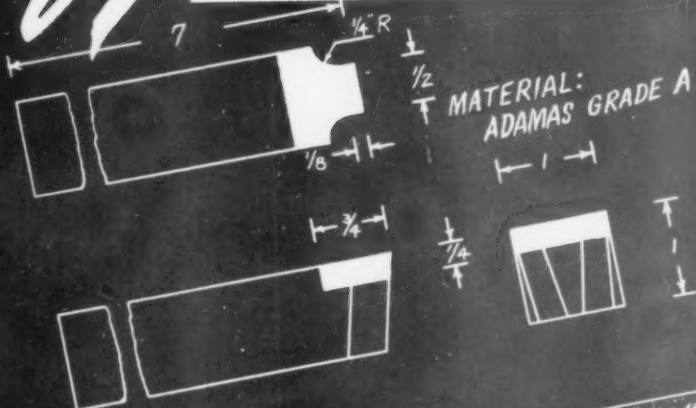
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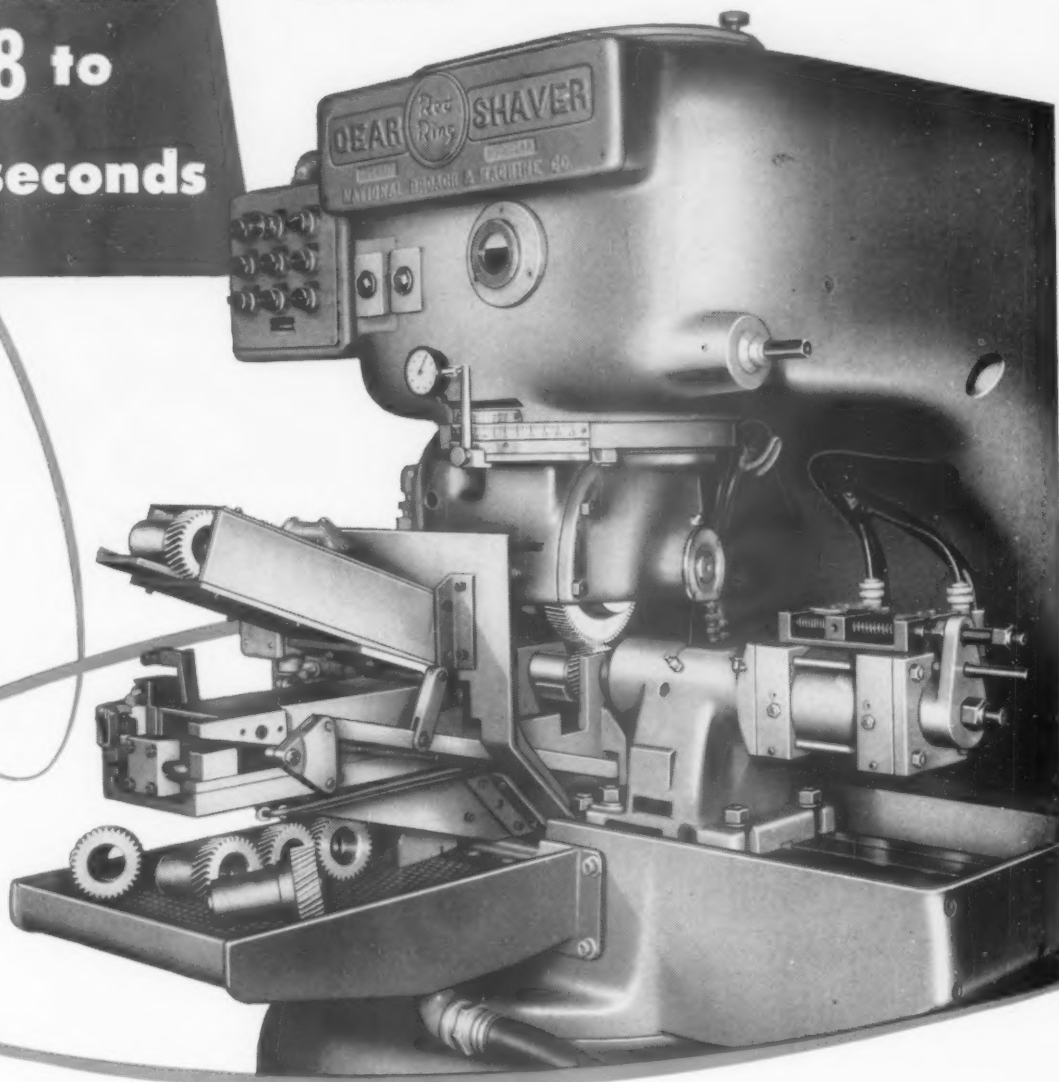
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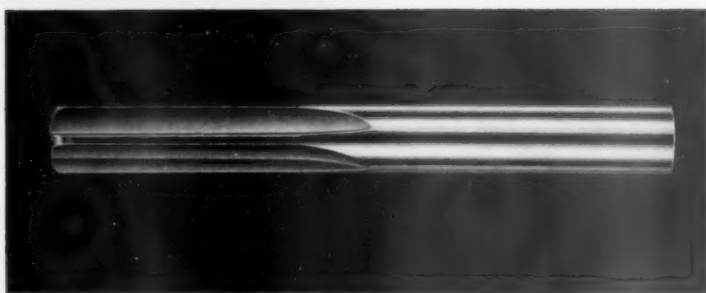
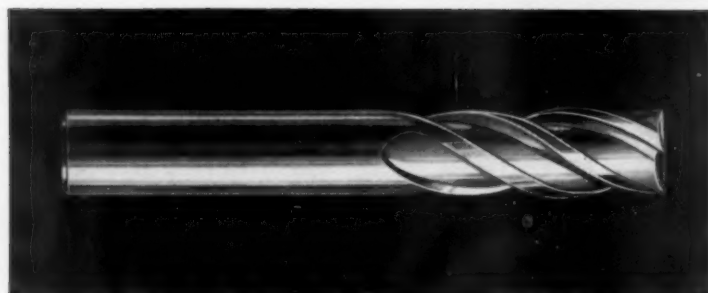
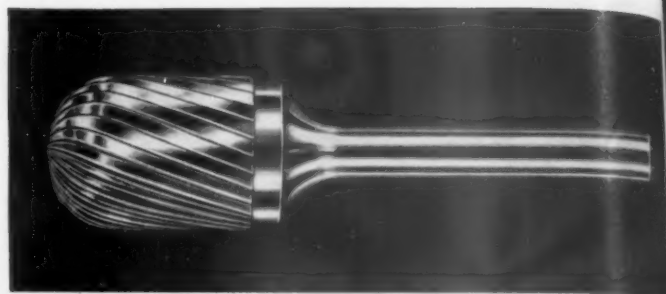


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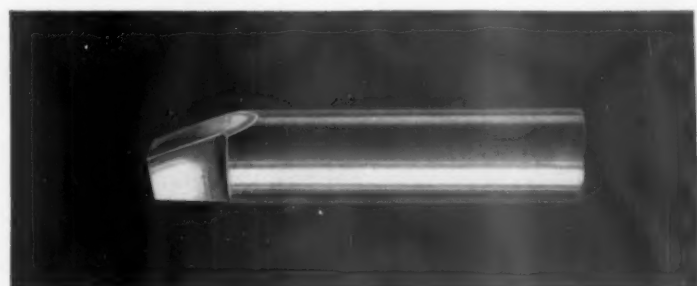
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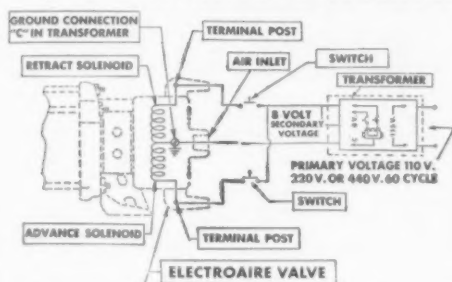
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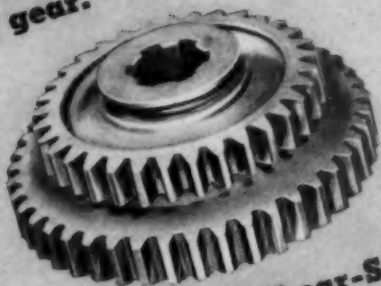
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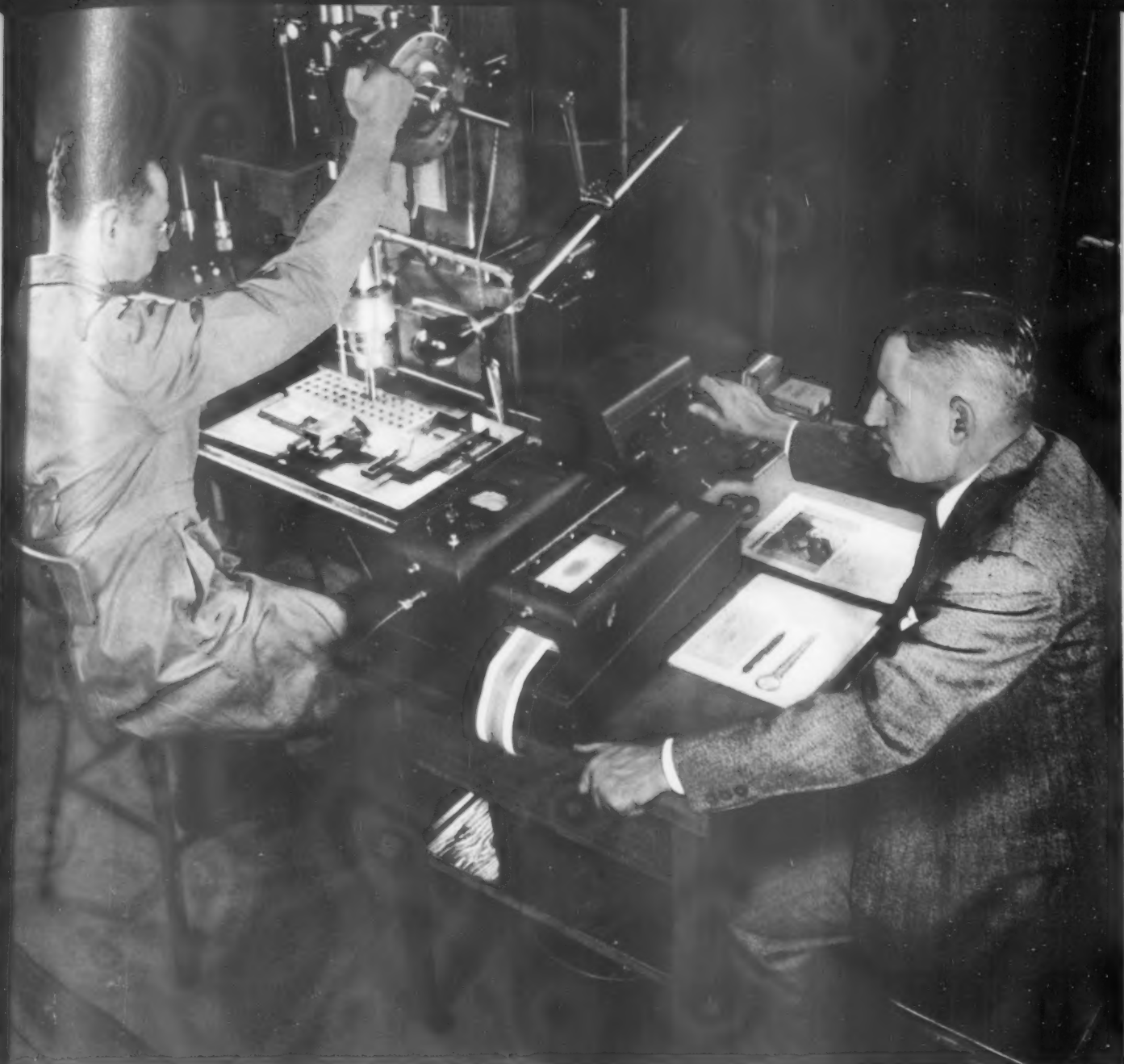
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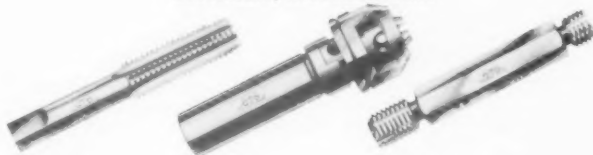
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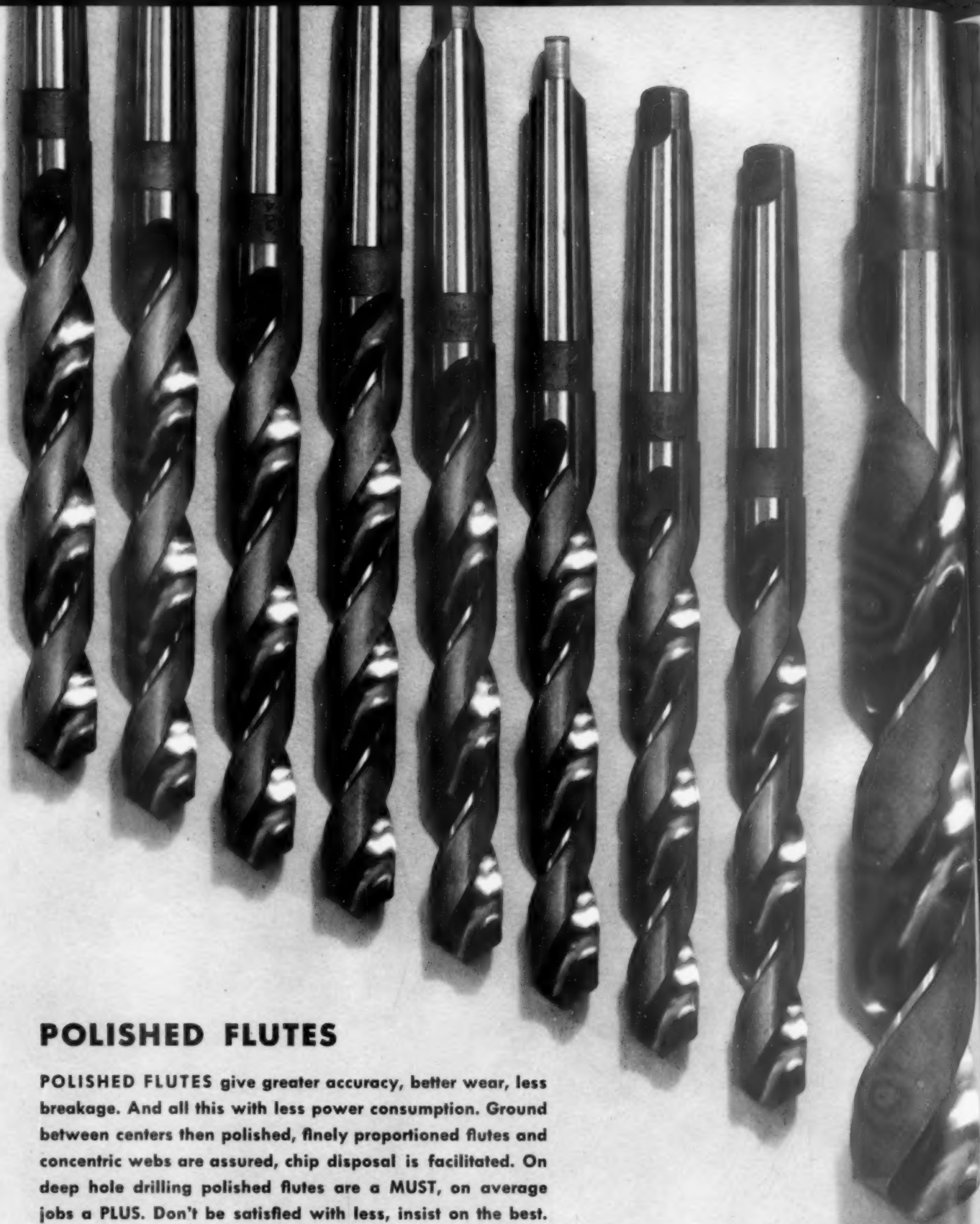
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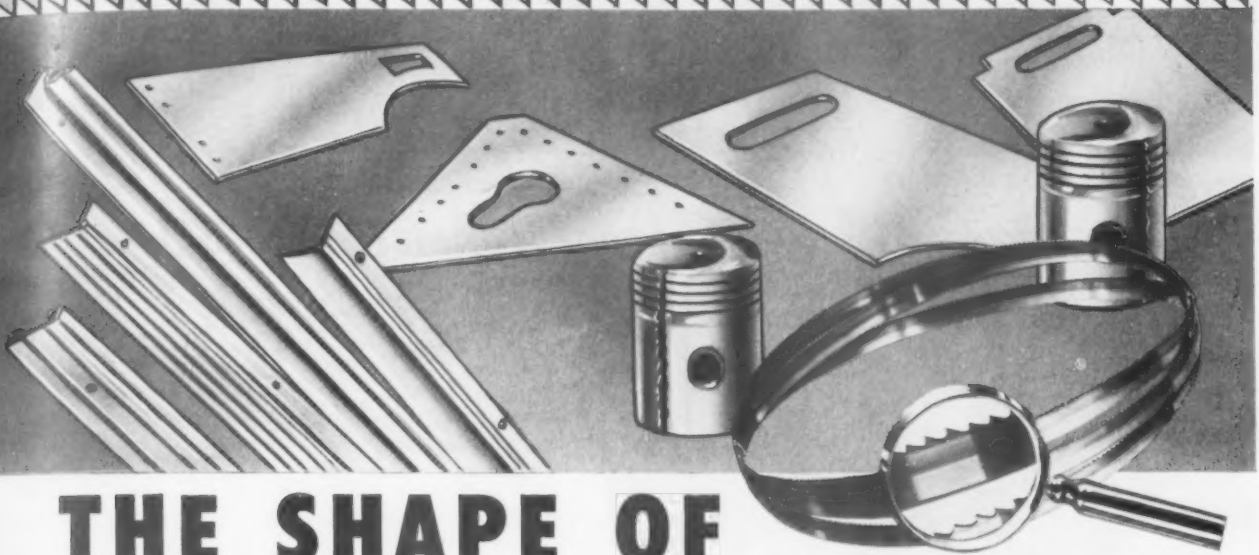
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All Ways*



There's a Barnes Blade for Every Purpose—all fully described in these two new folders—Ask your Barnes Distributor for literature on Barnes Band Saws and Barnes Hack Saws.



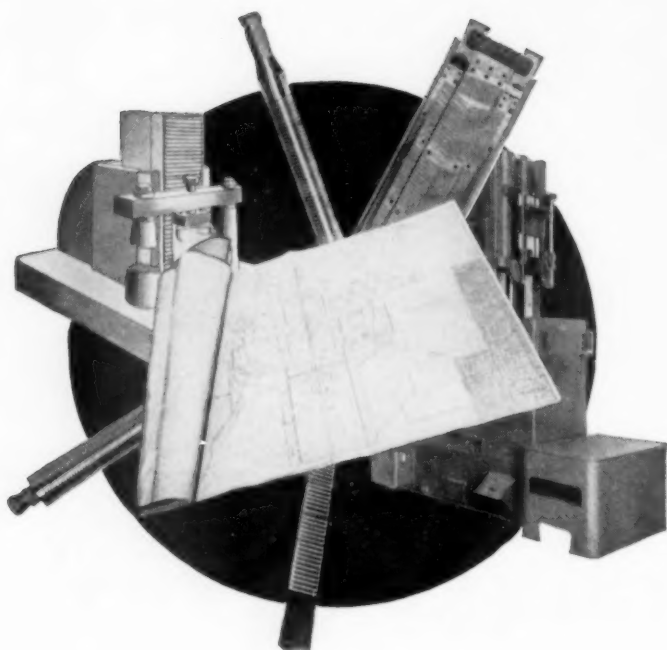
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Barnes CO., INC.

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"Endorsed Broaching"

**Are you using this
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One of the *troubles* with broaching is that the process is so fast and accurate that it is easy to be satisfied with the *initial* results obtained with almost any broaching installation.

Yet, time and again, Colonial Broach engineers have studied new or proposed broaching setups and pointed out where a different type of broach, machine or fixture would greatly improve the operation either as to productivity, product quality, or cost per piece—frequently all three.

Since broaching equipment is inherently expensive as to *first* cost, it is darn good protection to have an installation checked over by Colonial's broaching specialists before broaching equipment or tooling is ordered.

Once you have the equipment, *any* change usually means *increased* investment where previously it might have meant *less*.

And Colonial's "broaching protection" costs you nothing.

For Your Tool Room
A wall or bulletin board
poster of DO and
DON'T items that
should help you reduce
broach maintenance
cost. No charge. Ask for
BN-1250.



Tool Steel Topics



BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

The Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation



150,000 Stainless Spoons from Striking Dies of XX Carbon

The shaping of stainless steel can be a tricky job. A leading cutlery maker, faced with new problems in starting the production of stainless flatware, asked Bethlehem to recommend a tool steel suitable for striking dies. (The master dies are hand-engraved by craftsmen in the traditional fashion of this intricate art.)

The manufacturer adopted our recommendation of Bethlehem XX Carbon Tool Steel for this difficult operation. Results have been highly satisfactory. Spoons and other flatware are struck in quantities exceeding 150,000 pieces

Our Tool Steel Engineer Says:



Use thermocouple when you pack-harden tools

Whenever tools are pack-hardened (to reduce the scaling and decarburization) place a thermocouple in the pack against the tools so that the time the tools are at heat can be determined accurately.

Recently a 34-in.-diameter die ring of our Lehigh H (high-carbon, high-chromium) Tool Steel was pack-hardened by an experienced heat-treater. Treatment completed, he checked the hardness and was flabbergasted to find that he had obtained a hardness of only Rockwell C-48. Then he checked his pyrometer charts which proved, he thought, that he had followed the recommended heating cycle. Why the low hardness?

A Bethlehem trouble-shooter suggested that he insert a thermocouple in the pack against the ring. He did so, and this time got a hardness of Rockwell C-60—proving that in the first treatment the die ring wasn't heated long enough to reach the proper temperature, even though the records of the furnace heating cycle appeared to indicate correct treatment.

from one impression of the striking dies.

XX Carbon Tool Steel offers many advantages for general-purpose tools and dies. It's easy to machine and heat-treat; it develops a hard case, reinforced by a tough, shock-resisting core; it holds a keen cutting edge; it's economical; and there's a range of carbon content to meet many different requirements.

We closely control the hardenability of this grade, and give it a careful and uniform spheroidize-anneal. Bethlehem Carbon Tool Steels are the kind you can rely on for top performance.

BIG DIE OF A-H5 MAKES CAR PARTS

A massive die produces spring plates from 3/16-in. steel plate for hopper cars, at the Berwick, Pa., plant of American Car & Foundry. All wearing surfaces of the die, which performs a punching, blanking, and forming operation, are made of A-H5 Tool Steel.

This leading car-builder uses this 5-pct-chromium, air-hardening tool steel to produce car parts from carbon steel, low-alloy high-tensile steel, and aluminum. A.C.F.'s experience with A-H5 confirms its good machinability, its high resistance to wear and distortion, and its sharp, durable cutting edges.

Here's a general-purpose, air-hardening grade of steel that's hard to beat when safer hardening and high wear-resistance are of special importance.



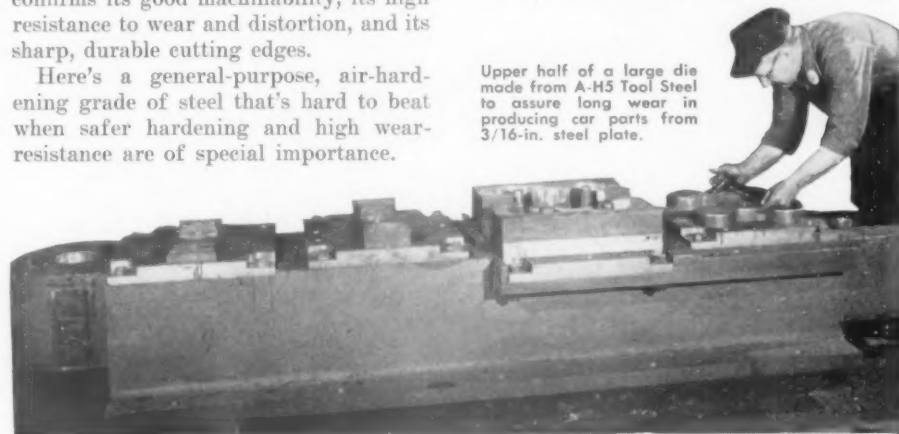
Prompt shipment to our distributors is made possible by our modern tool-steel depot at Bethlehem, Pa. Complete sizes of 23 different grades are stocked.

Tool Steel Distributors Give Service in a Hurry

Delivering tool steel in a hurry is only one of the many services performed by the distributor. He knows local requirements, and he carries large stocks of the tool steel grades and sizes that his customers are most likely to require. He's ready at any time to go into action to see that your tool steel needs are taken care of, whether it means cutting bars to exact size or lending a hand in recommending the kind of heat-treatment you'll need.

Having a tool-steel distributor in your neighborhood makes it unnecessary for you to carry large inventories of tool steel . . . and he often carries other steel specialties that you use frequently.

Distributors of Bethlehem Tool Steels are reputable, experienced firms. They render a real service in all parts of the country. We are proud to have them so closely linked with our sales organization.



Upper half of a large die made from A-H5 Tool Steel to assure long wear in producing car parts from 3/16-in. steel plate.

Bethlehem  **Tool Steel**

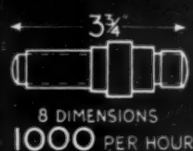
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- Checks External or Internal Dimensions, Depths, Profiles, Concentricity, Tapers, Squareness of Faces.
- Easily and quickly set to the required tolerances.
- Rapid change of set-up from one part to another.
- Handles pieces from $\frac{1}{2}$ " to 4" wide and up to 8" long.
- Results are instantly visible by signal lights.
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Sigma Automatic Multi-dimensional Inspection Machine with magazine feed for checking six dimensions on wheel studs. Output: 2,500 per hour.

Send us blue prints or samples of parts you want checked, giving us your inspection requirements. Our Engineers will be glad to make suitable recommendations.

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EVERY 20 SECONDS!

One of a multitude of possible applications for the Baker 15 x 16 Hydraulic Unit is this new Baker single end horizontal trunnion type indexing machine with 7 stations, which is capable of an estimated hourly production of 652 pieces at 100% efficiency. Operations include drilling, facing, chamfering and tapping. Chutes are provided (see arrow) for the parts which are automatically ejected from the fixture into conveyances. The new Baker features automatic clamping by hydraulics, tapping with individual leadscrew tapper and outside portable hydraulic pump sump unit. Write Baker regarding your specific job problems.

BAKER HYDRAULIC MACHINE



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EJECTION CHUTE
PLACES FINISHED
PARTS IN
CONVEYANCE

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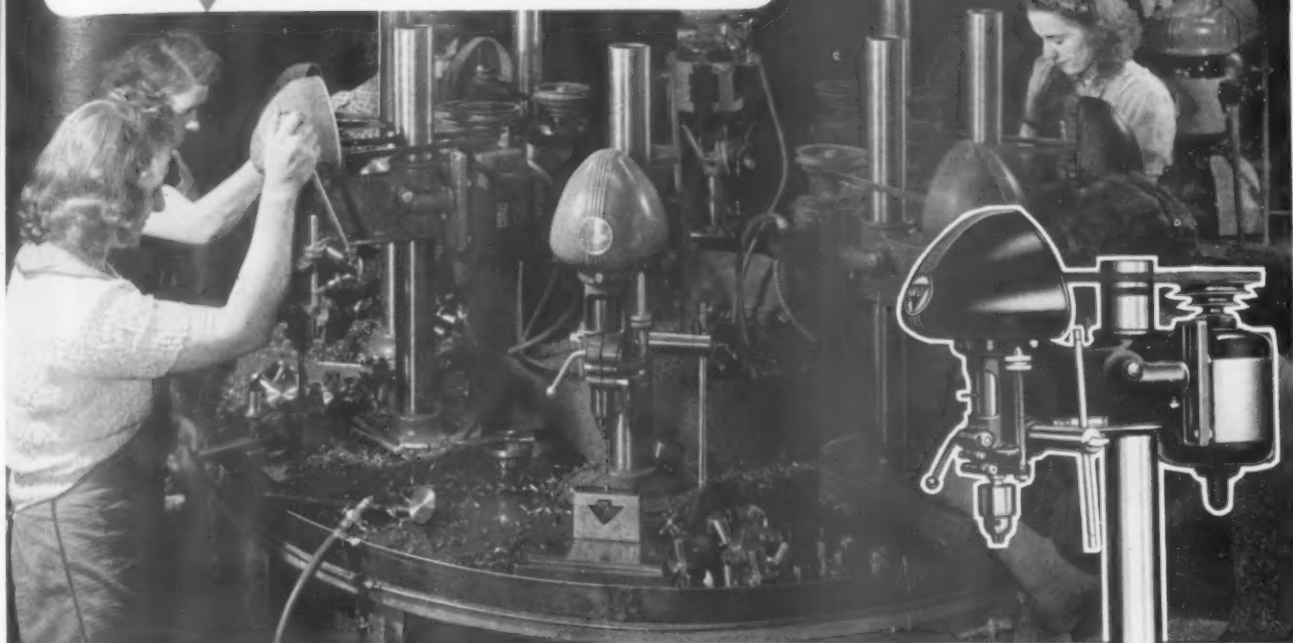
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DELTA MILWAUKEE

8 standard 14" Delta Drill Presses mounted on circular table at Boxer Tool and Mfg. Co., Chicago for high production with minimum materials-handling in multi-stage operation on bomb fuse. Bench type 17" Drill Press in background mills two slots in fuse-striker face in next phase of operation.



Quick relief for shortage headaches

—low-cost Delta® tools make easy-to-use set-ups
when men and machines are scarce

Basic materials are already in short supply. The next pinch will be on men and machines. That's when Delta versatility, plus your own imagination, can save the day. The space-saving, special drill-unit above is only one of hundreds of examples in our files. Its rotary table simplifies parts handling—and dependable Delta drill presses (with fixtures) assure close-tolerance accuracy from untrained operators.

Remember to count on Delta to solve your own drilling problems. A little ingenuity gives you a quick, low-cost solution to meet production's critical standards and rugged schedules.

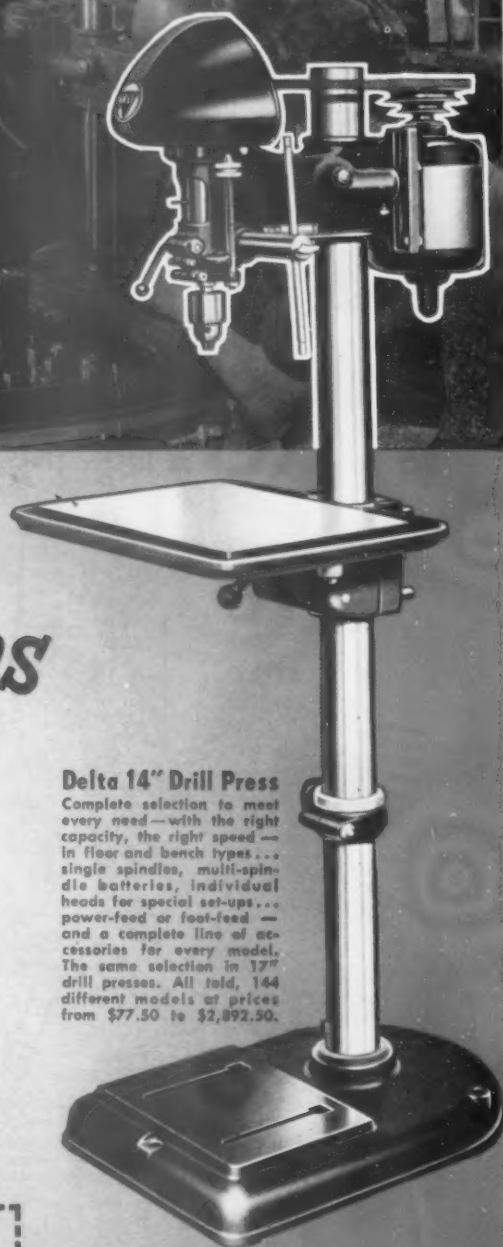
Send for complete details—and plan your jobs around the versatility of dependable Delta tools—high in quality, low in cost! Delta's engineering service is always ready to help you. Sold only through authorized dealers—available on easy time payments. Look for the name of your Delta dealer under "Tools" in the classified section of your telephone directory.

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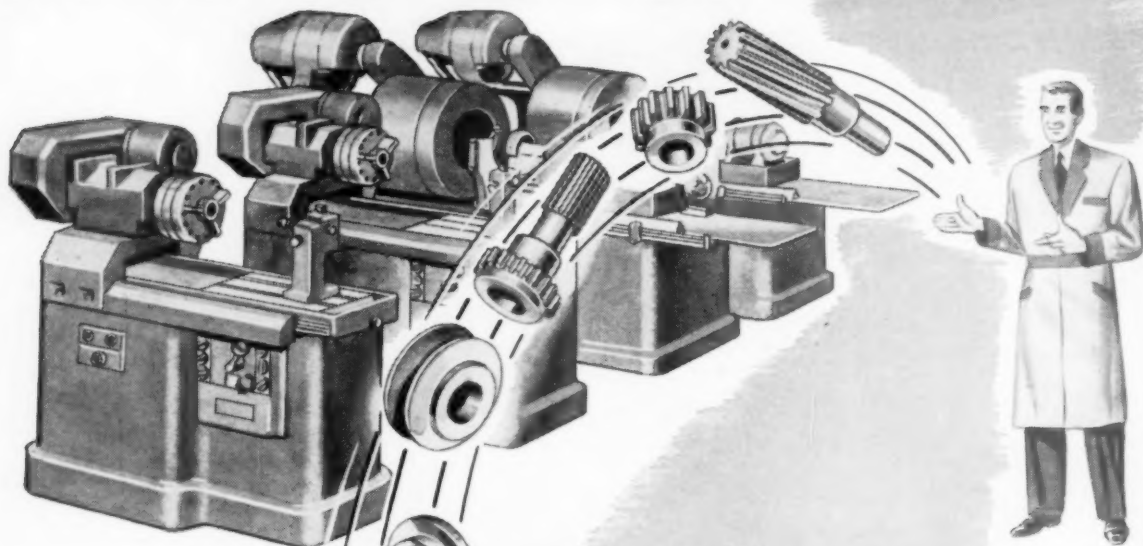
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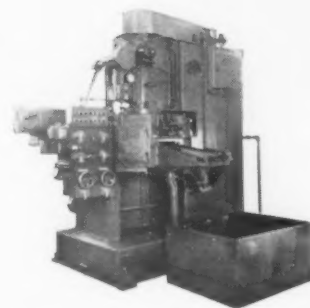
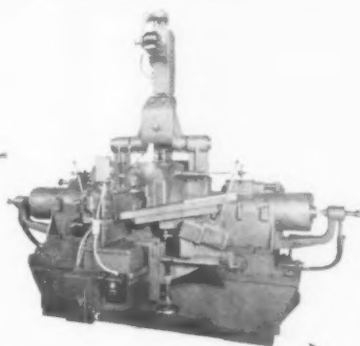
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**Now Produce As Much
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No. 926-30" Besly Double
Vertical Spindle Grinder

No. 226-30" Besly Double
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• These three new Besly Grinders provide a superior product and more output per man-hour for one of the country's leading piston ring manufacturers. Specific savings include:

1. A reduced capital investment—with first cost cut by the sale of the old-style grinders.
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Formerly, it took 40 machines to meet production requirements; today, 3 Besly Grinders do the work . . . and, actually exceed accuracy specifications for finish, parallelism and flatness. Scrap is reduced and the need for 100% inspection eliminated.

If your product requires precision-finished surfaces in quantity, Besly may be able to show you the way to greater production at lower cost. A Besly engineer will gladly consult with you without obligation.

JOB PRODUCTION FACTS

No. 226-30" Besly Grinder grinds up to 490 passes per minute on 2 3/4" diam. x 3/32" rings (kayspun material or cast iron). Removes .010" in three passes—holding size from ring to ring within plus or minus .0001 and parallelism within .0001. Then, on the Besly No. 926-30" Piston Ring Finisher, two or three passes, according to requirements, are taken—holding the same close tolerances . . . and grinding 250 passes per minute. Three machines outproduce forty because more stock is removed per pass—at a rate of four times as many passes per minute. Time required for changes from one job to another is reduced sharply for many operations.

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Hi-Den, made from selected wood veneers impregnated with phenolic resin (laminated and compressed at extremely high pressures), is **far stronger than equal weight in steel!** It has been successfully used for nearly 10 years in the aircraft and other metal working industries for dies, jigs, pressure pads, spinning chucks, etc.

Amazing savings are being made with Hi-Den. An aircraft manufacturer* found over 100 different applications for it; a bus manufacturer* used Hi-Den for forming and drawing dies, got a **50% greater depth of draw** than when using a steel die, never had a breakdown or replacement in a 3-year period, and some dies produced **more than 8,000 parts!**

Hi-Den is stronger, has a low coefficient of friction, is superior in drawing sheet metals, is lighter in weight and easier to handle, has dimensional stability and is **extremely versatile.**

INVESTIGATE THIS REMARKABLE NEW MATERIAL!

Send today for technical bulletin "HOW TO USE Hi-Den" to improve quality while reducing costs.

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Columbia TOOL STEEL

PRODUCTION METAL CUTTING—

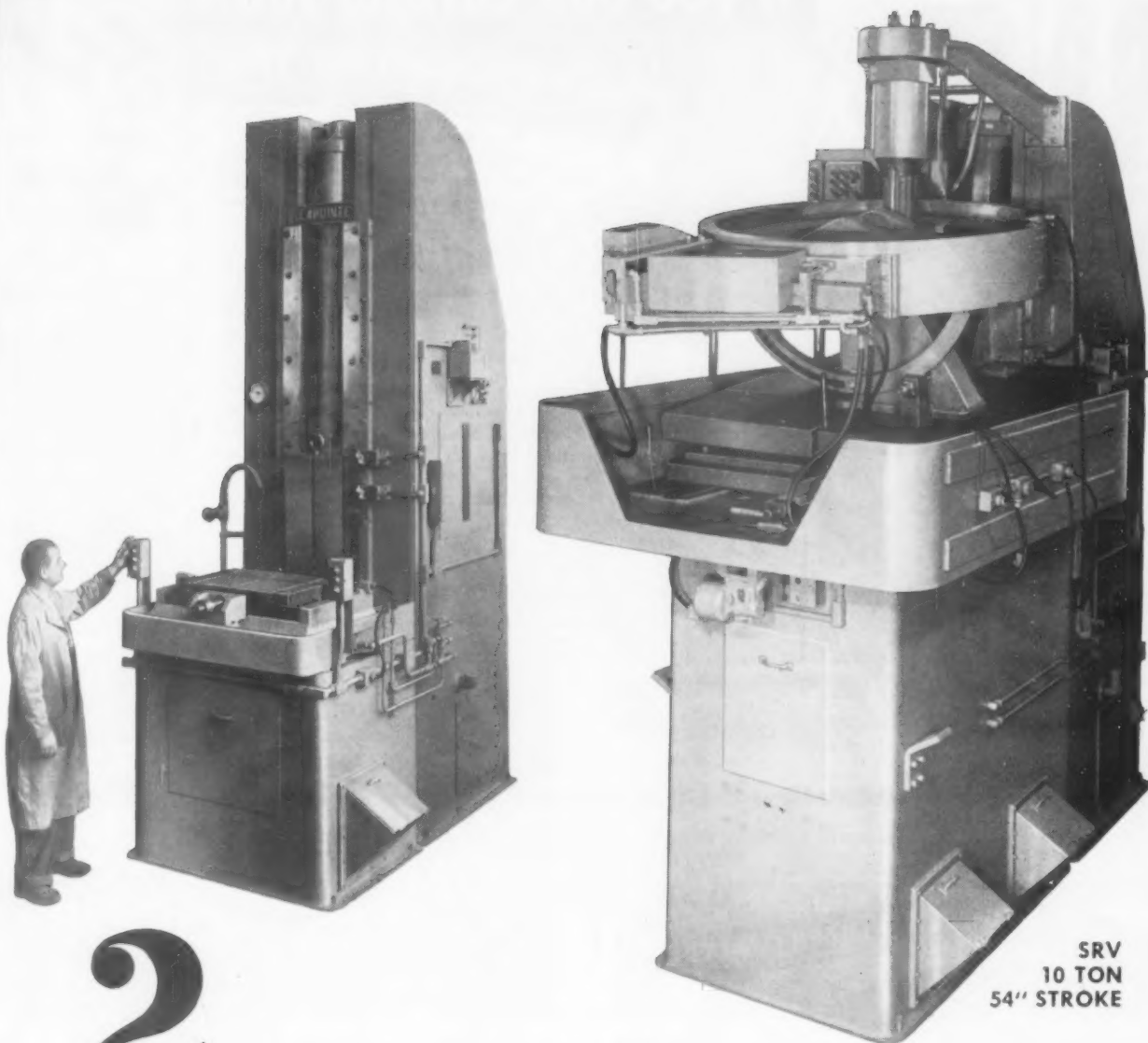
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MOLITE molybdenum-tungsten high speed steel is a proven producer, exempt from restrictions and freely available.

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The Tool Engineer



2

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- ✓ *Maybe this is your answer* to the problem of how to tool up for defense contracts without running the risk of having needless machines on hand when those contracts are completed.
- ✓ You will be impressed with the many possibilities of Broaching by Lapointe. We suggest that you write, today, for our

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Slitting Saws

Spec. Carbide Tipped

Inserted Blade Cutters

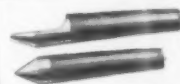
Spec. H.S.S. Tools

Rolls & Slitters

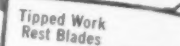
Ground Cutoff Blades



Tool Bits



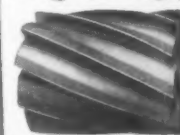
"M-40-U" Alloy Centers



Tipped Work Rest Blades



Std. H.S.S. Cutters



Railroad Turning Tools

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-3-154-1



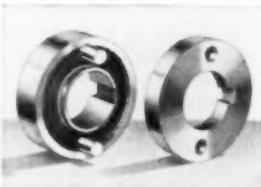
Consult Your Local Distributor for Full Information

Yes, sir! a complete line in all diameters to meet every slitting and slotting requirement:

- (1) **Master-Cut**—a standard blade, for milling machine purposes generally.
- (2) **Triple-Chip**—a deluxe blade, for low cost operation and highest production with accuracy.

Also, special blades to order. Contact your local dealer or write us in Cleveland for full information.

Ask for Bulletin 250-T.

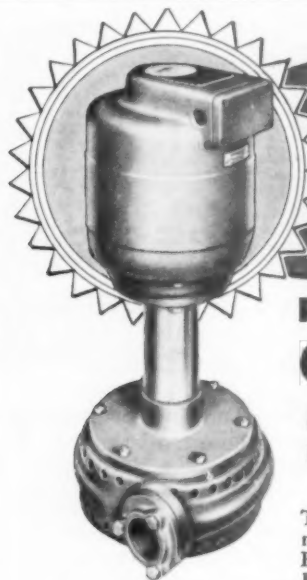


Dual Drive Adaptors optional on all M. & M. slitting and slotting blades. Dual Drive reduces stresses on driving means; makes possible blade interchangeability.

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The leading manufacturers of metal-cutting equipment install Ruthman Gusher Coolant Pumps on their machines because they know from experience that Gusher Coolant Pumps combine top performance with long trouble-free life.

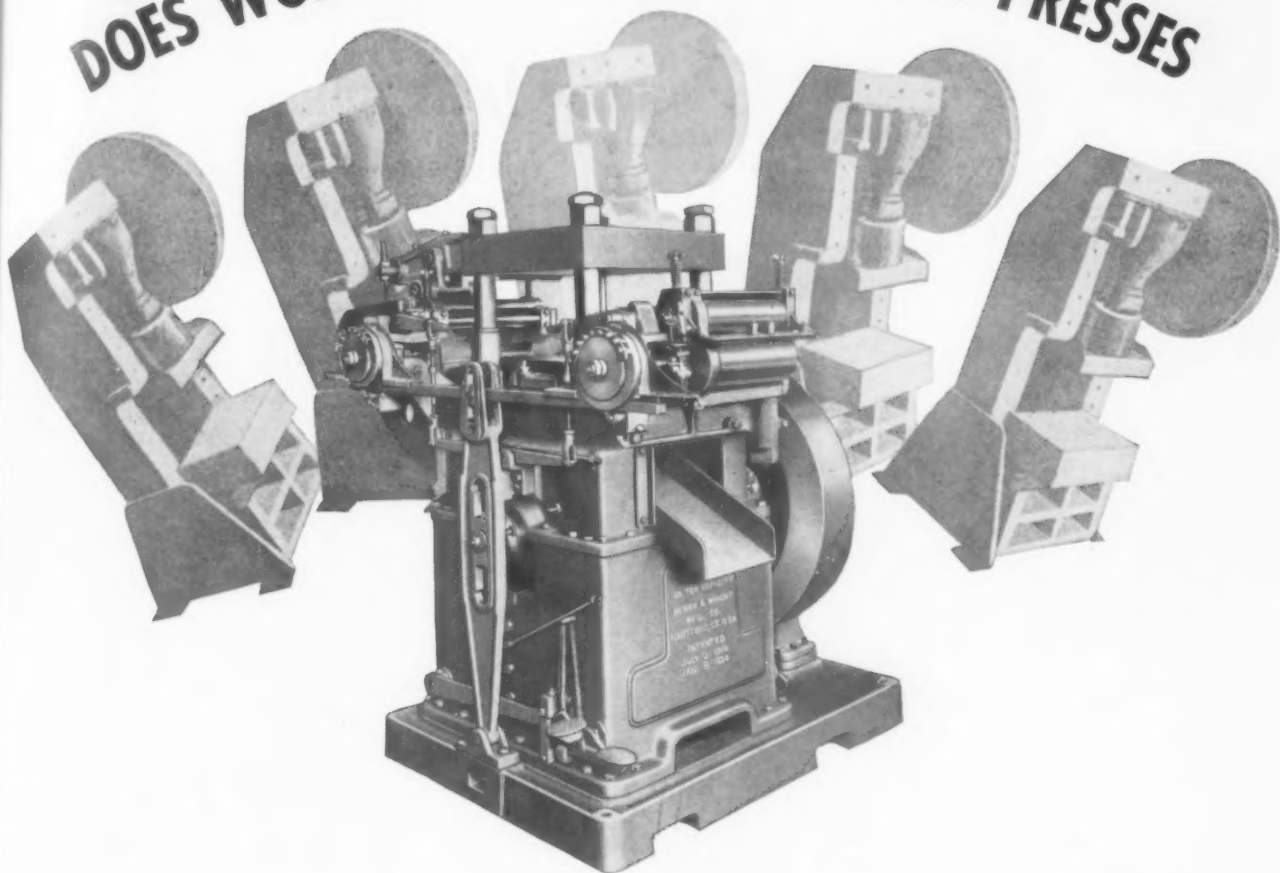
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THE RUTHMAN MACHINERY CO.
1810 Reading Rd. CINCINNATI, OHIO

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The Tool Engineer

ONE HENRY & WRIGHT DIEING MACHINE DOES WORK OF 5 TO 10 ORDINARY PRESSES



Complete-per-stroke production on Henry & Wright Dieing Machines is the modern, cost-saving method of fabricating simple and complex stampings. Instead of a series of interrupted operations, you get the job completed on one machine. One Henry & Wright Dieing Machine customarily does the work of 5 to 10 ordinary presses.

Your die investment is protected, too, because our machines are designed to have the lower crosshead absorb the angular thrust of the crankshaft — it is not transmitted to the punch-carrying member. This improvement increases die life up to 1200% and it means more pieces between

grinds. Get complete details on Henry & Wright Dieing Machines. You may save as much as 60% to 90% on your stamping costs. Write for catalog 49. If you wish, we can have a technical representative pay you a visit.

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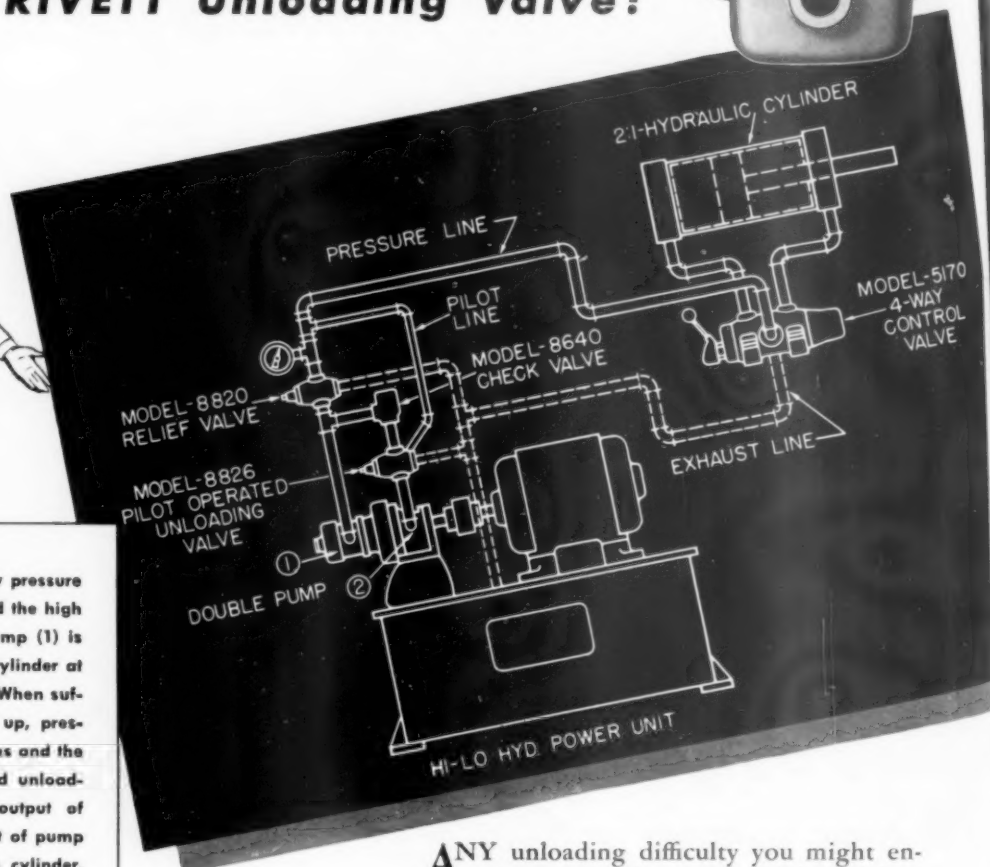
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DIVISION OF HARTFORD-EMPIRE COMPANY

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Dumping a Problem—

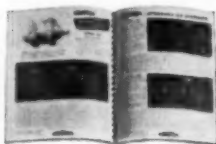
with this RIVETT Unloading Valve!



The output of both the low pressure high volume pump (2) and the high pressure small volume pump (1) is directed to the hydraulic cylinder at a low operating pressure. When sufficient work load builds up, pressure in the system increases and the Model 8826 pilot operated unloading valve unloads the output of pump (2) while the output of pump (1) is still directed to the cylinder. Direction of piston travel is controlled by Model 5170 hand operated 4-way control valve.

RIVETT CATALOG
NO. 202 IS A MUST
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52 pages illustrate
and describe all types
of hydraulic valves.



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ANY unloading difficulty you might encounter in planning a high and low pressure circuit can be solved by use of the Rivett Model 8826 Unloading Valve. It is employed in oil hydraulic circuits to unload one part of the circuit at no back pressure to the tank, and is operated by pilot pressure from some other part of the circuit. Free flow to tank continues as long as the pilot pressure is higher than the setting of the valve. Available in sizes $\frac{1}{4}$ " to $1\frac{1}{2}$ ", in two pressure ranges, adjustable from minimum to maximum in each range. RIVETT LATHE & GRINDER, INC., Dept. TE-3, Brighton 35, Boston, Massachusetts.

Now, you too can cut costs on almost any machining job

... with **Versa-Mil**

BECAUSE of its flexibility, rigidity and accuracy, Versa-Mil brings to precision machining *new savings* in handling, preparation and set-up time.

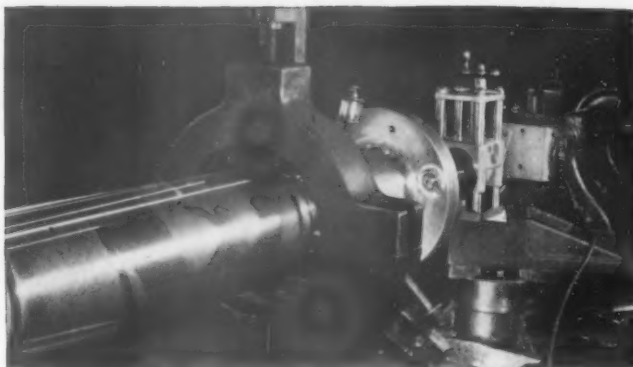
It can take on practically any job you may encounter. Mounted on almost any machine tool, it readily performs such operations as drilling, milling, slotting, grinding. Parts formerly requiring two or more machine tools are now often finished on a single machine with a single set-up. Many large surfaces are finished in one continuous operation without re-setting the work piece.

Versa-Mil brings tool to the work!

A portable machine tool, Versa-Mil can be *taken to the work*. This avoids the cost of bringing the work to the shop. It also means sizeable savings in disassembly and transportation that on one turbine repair job, for example, resulted in Versa-Mil paying for itself in two days' use!

Write for further details on how *you* can profit with this compact, precision tool... in production, in heavy machining, in plant maintenance, in small-shop work.

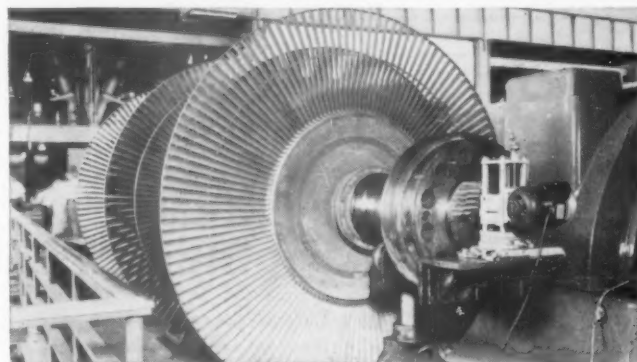
VERSA-MIL COMPANY
30 Church Street, New York 7, N. Y.



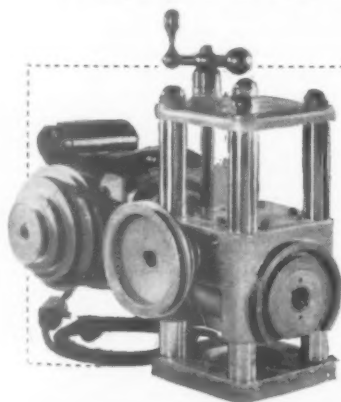
MACHINING DIFFICULT PIECES: Back spot facing coupling holes on a large heavy shaft, 13 ft. long x 9 in. diameter, with complete freedom from chatter on 3" diameter cut.



CYLINDRICAL GRINDING: By mounting Versa-Mil on vertical turret lathe or other large machine tools, cylindrical grinding on pieces beyond the capacity of most lathes is readily performed.



TAKING THE TOOL TO THE WORK: Removing $\frac{1}{4}$ " (in one pass) from face of vanadium-steel turbine-coupling. By machining in turbine room, downtime is reduced from 2 weeks to 2 days.



Versa-Mil Basic Unit

6" travel on posts
#3 Morse taper
6" x 6 1/4" base
Weight: 89 lbs. with
1/2 hp. AC motor
104 lbs. with 3/4
hp. AC motor

A TOOL IS KNOWN BY THE COMPANY IT KEEPS!

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Fairchild Engine & Airplane Corp.
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New York Central Railroad
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Phelps Dodge Copper Products Corp.
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Many of these companies and also others have re-ordered additional units again and again!

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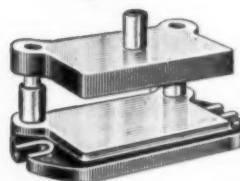
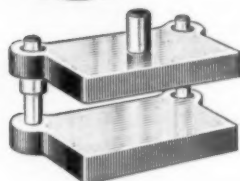
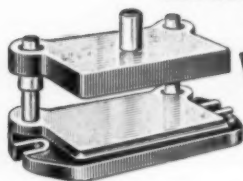
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Ames No. 1 Dial Comparator — measures objects up to 2" in cross section. Adjustable table with positive locking screw. Height 9 1/2", weight 4 lbs., Dial Indicator graduated .001", with .250" range.

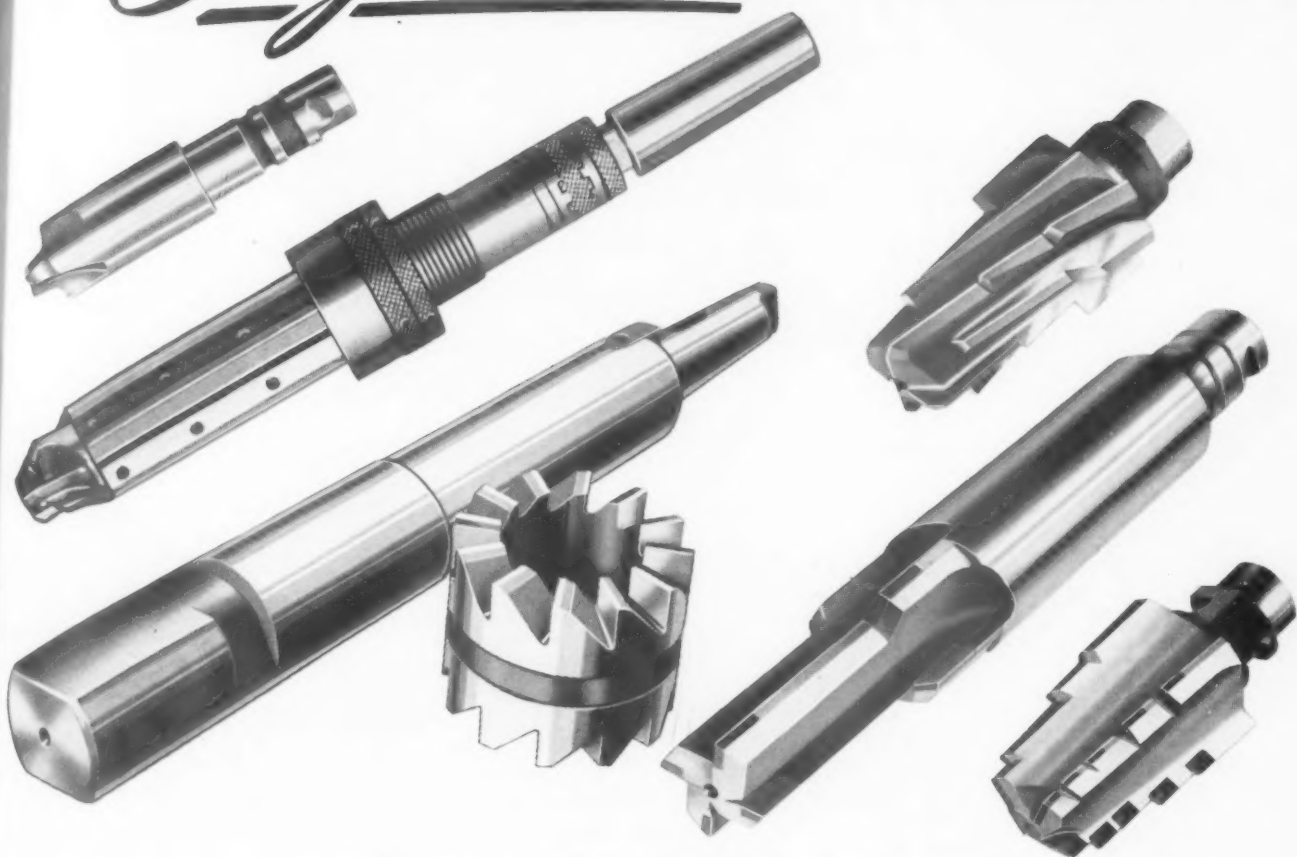
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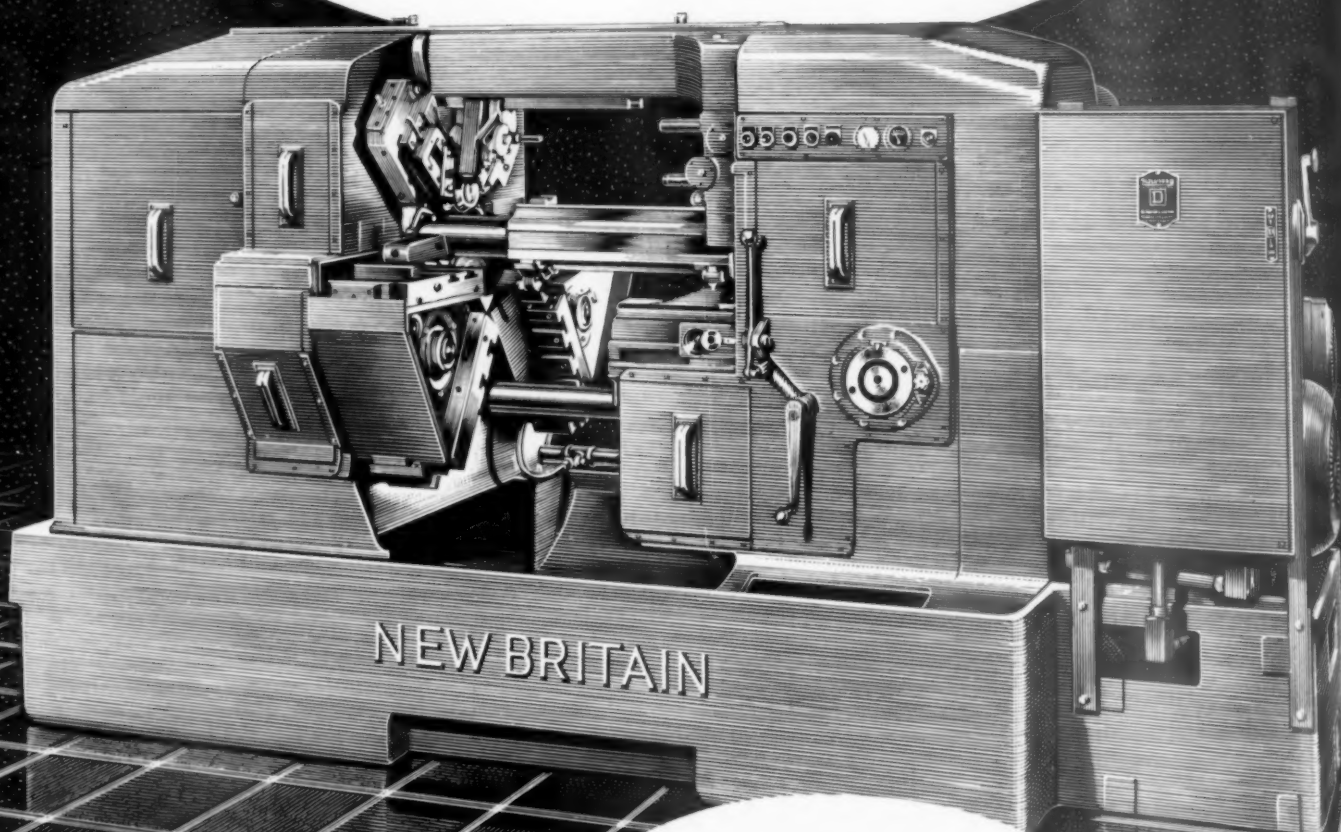
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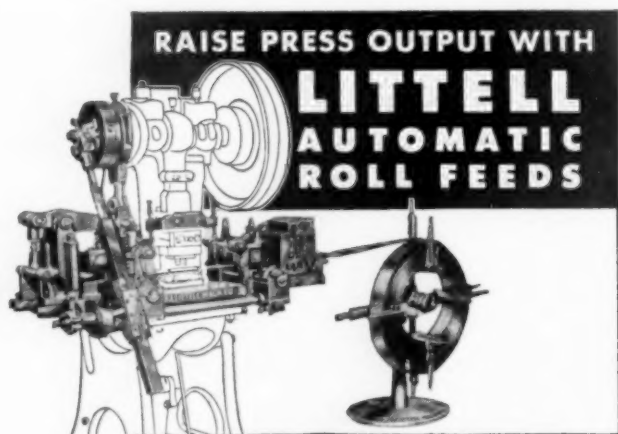
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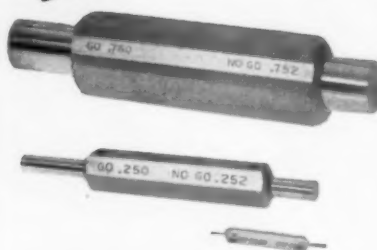
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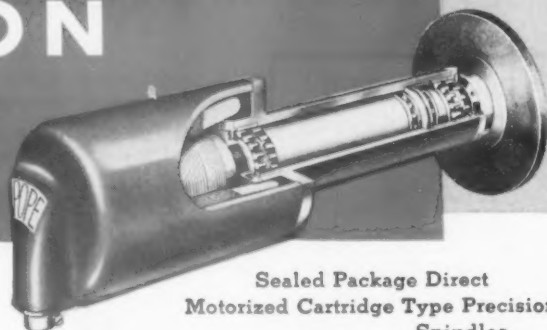
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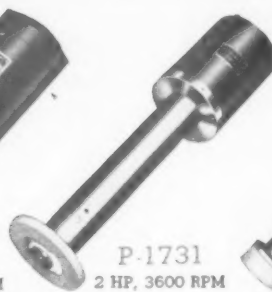
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Here's Why:

- POPE Spindles produce finer finishes.** They have the necessary massive construction and the radial and axial rigidity — *two double-row, super-precision, cylindrical roller bearings and two separate ball thrust bearings.*
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½ HP, 3600 RPM



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5 HP, 3600 RPM



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RPM (Shown in
bracket). Mount-
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available for all
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No. 75

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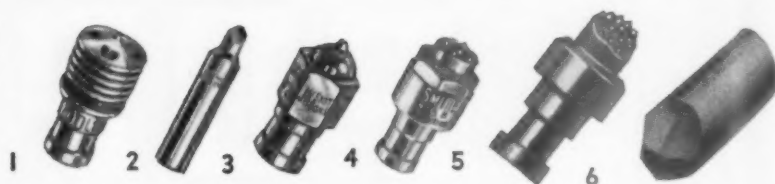
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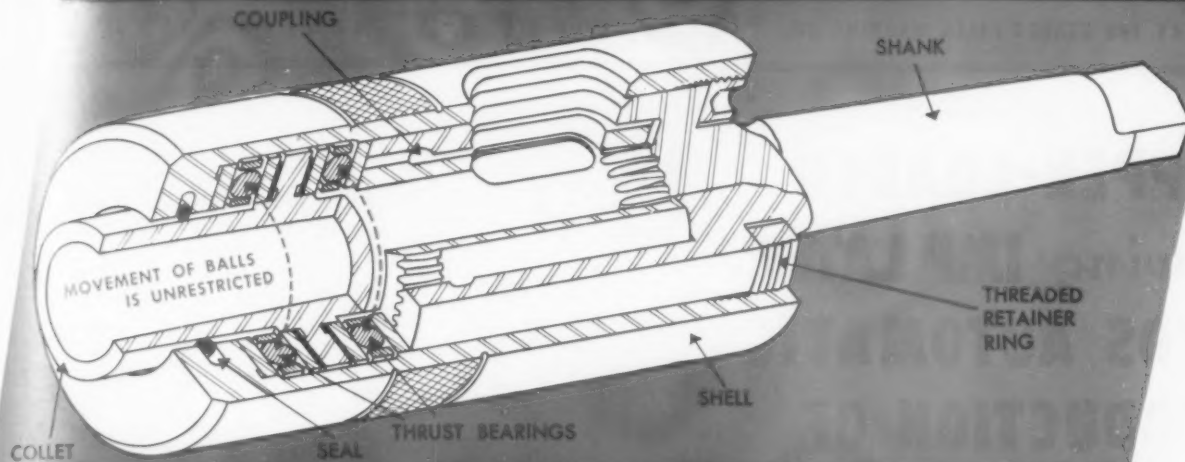
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"JA" FLOATING HOLDERS

Get these advantages . . . proven in the field:

UNIFORM CUTTING OPERATIONS

Clearance in the double-gear spline drive allows free movement of the floating and driving elements. This prevents binding and eliminates "dead" spots or zones which often cause rejects.

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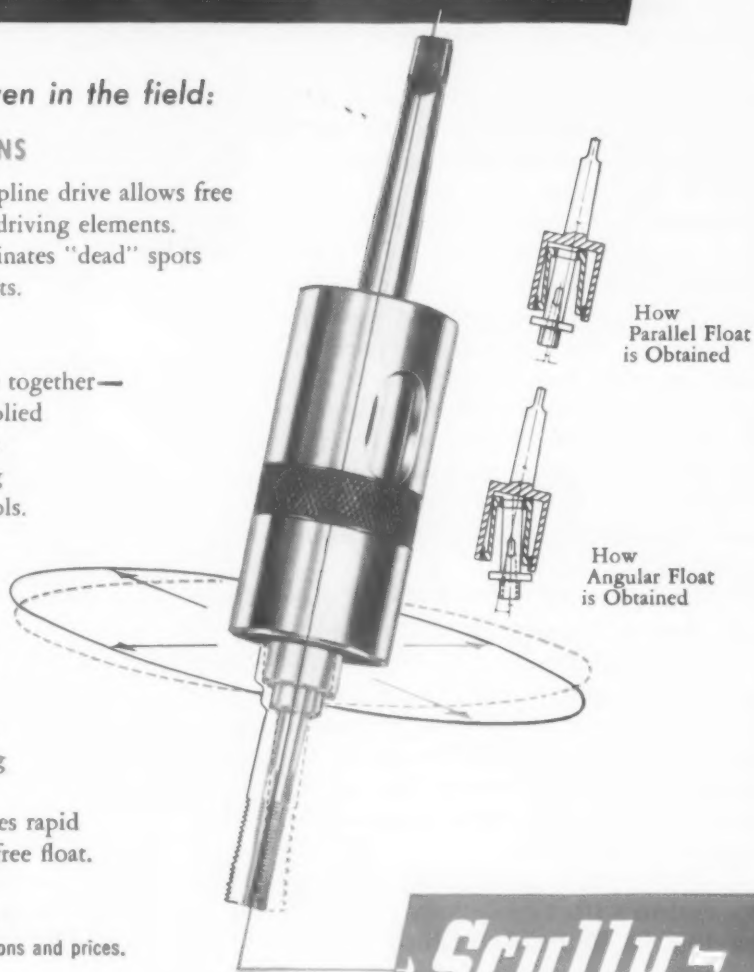
Two thrust bearings—placed close together—minimize the effect of the force applied on the tool by the hole. Thus, tools float freely into alignment—reducing down time and damage to cutting tools.

TROUBLE-FREE OPERATION

Balls are free to move in the required direction or rotate around the collet, because the floating element is separated from the drive. Free movement of the balls eliminates confined reciprocating motion. This greatly reduces the scrubbing action characteristic of small rocking movements. The scrubbing action often causes rapid destruction of ball-thrust plates and prevents free float.

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March, 1951

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165

MACHINE OF THE MONTH

PREPARED BY THE SENECA FALLS MACHINE CO. "THE Lo-swing PEOPLE" SENECA FALLS, NEW YORK

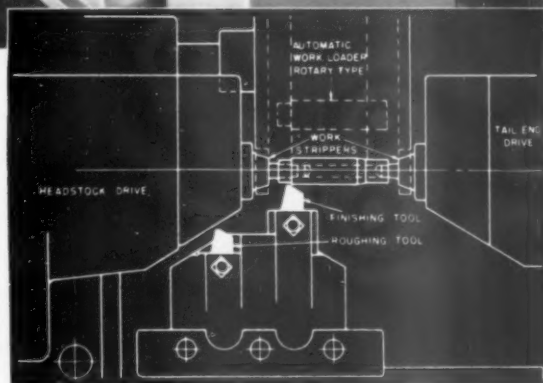
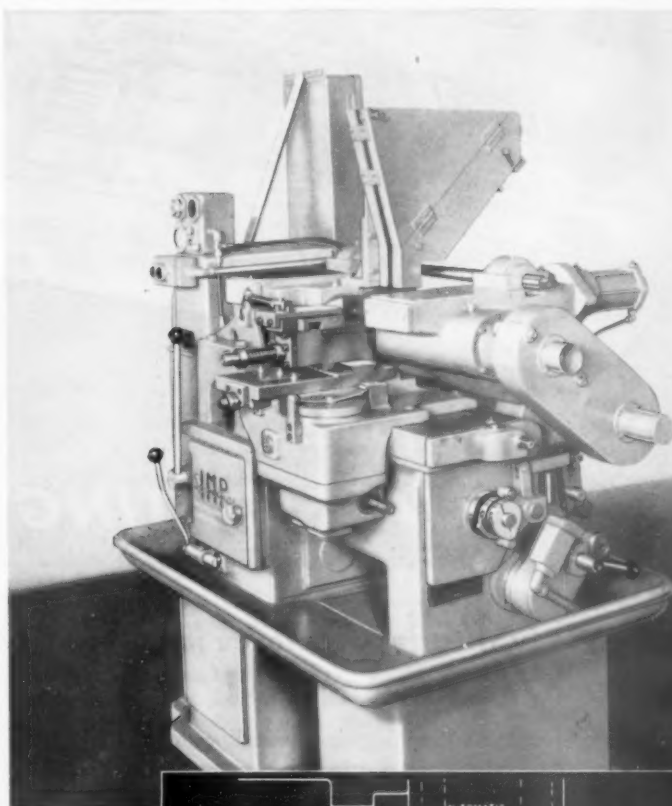
HOPPER-LOADED Lo-swing IMP LATHE SPEEDS AUTOMATIC PRODUCTION OF VALVE GUIDES

Problem: To automatically load, rough and finish turn and automatically eject valve guides on a high production basis.

Solution: The Lo-swing IMP Automatic Lathe selected for this job was equipped with a Rotary Type Loader and a newly designed Hopper (capacity 200 pieces) which assure a constant flow of Valve Guides through the machine on a completely automatic cycle. This lathe is also equipped with revolving head and tailstock spindles driven from a splined jackshaft. The advantage of the double-end drive is twofold. Since the piece is driven from both ends, much coarser carriage feeds are possible, thereby considerably increasing production. Also, the double-end drive assures synchronization of the speed of both spindles and eliminates slip-page wear on the centers.

Valve Guides, which have been previously bored to size, are placed in the hopper and fed by gravity into openings in the Rotary Loader. A mechanically operated agitator prevents the parts from jamming as these approach the lead-in chute. The Rotary Loader indexes the pieces to the proper position, where they are automatically picked up by the continuously revolving centers of both heads.

The O. D. is rough and finish turned in the same operation with two separate carbide tools, each having its individual rate of feed. The



finish turning tool begins cutting after the roughing tool has been relieved from the work, thereby assuring close concentricity between bore and finished diameter. The Rotary Type Loader assures complete control over the fast revolving pieces, eliminating danger to personnel and damage to the pieces which are completely stationary by the time they reach the discharge chute.

SENECA FALLS MACHINE CO., SENECA FALLS, N. Y.

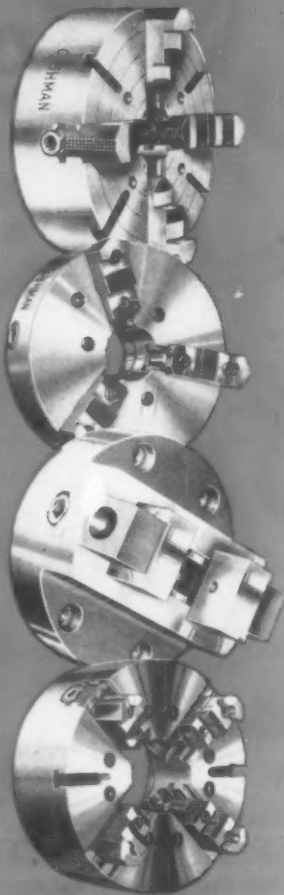
PRODUCTION COSTS ARE LOWER WITH Lo-swing

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Unless your key production machine tools are properly equipped with the right chucks and jaws . . . in perfect condition . . . and tested for centering accuracy . . . you will inevitably face production delays and high rejects.

We suggest a comprehensive and careful chuck survey of your plant right now. Check the condition and age of chucks and jaw sets. . .

The *Essential* CHUCKS



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It contains time studies of output per cycle and per day, in slitting different widths, gauges and coil weights.

It shows how cycle time is affected by these and other factors; advantages of big coils and high speeds for big tonnages; economies of smaller, less expensive, standardized sizes of slitters for the more moderate

requirements of most metal working plants.

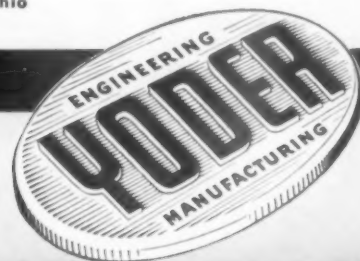
Cost analyses show how Yoder slitters, operating only three or four days per month, often pay for themselves in a year or two. In addition, they greatly reduce inventory requirements of slit strands and facilitate production planning.

Phone or write today for free copy. Estimates and recommendations for the asking.

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Complete Production Lines

- ★ COLD-ROLL-FORMING and auxiliary machinery
- ★ GANG SLITTING LINES for Coils and Sheets
- ★ PIPE and TUBE MILLS—cold forming and welding





PARKER • MAJESTIC



PRECISION MACHINES

*Above is pictured the home and products of the
PARKER-MAJESTIC, INC.*

For over twenty-one years this company has manufactured the Parker Spindles used in Precision Grinding, Boring and Milling applications.

Supplementary products include the well known line of Parker-Majestic Internal, External, No. 2 Surface and Rotary Surface Grinders.

Descriptive literature upon request.

PARKER-MAJESTIC, INC.

formerly **MAJESTIC TOOL & MFG. CO.**

147 JOS. CAMPAU

• DETROIT 7, MICHIGAN

MAKES *Tough* SET-UP *Jobs* EASY



The tougher the set-up is on tapping and reaming jobs, the more you will appreciate Ziegler Floating Tool Holders —because the Ziegler makes it possible to turn out perfect work even though the set-up itself may not be perfect.

The secret lies in the fact that the Ziegler Holder compensates for inaccuracies in set-up even though they amount to as much as 1/32" on the radius or 1/16" on the diameter.

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Ziegler
ROLLER DRIVE **FLOATING HOLDER**
for Taps and Reamers...

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Patents Pending

One of the most difficult problems in tool making can be solved easily and quickly with Sturdy Square Holed Sleeves. The perfection of broached square holes can be had in boring bars, milling cutters and many other applications at a small fraction of the cost of imperfect hand-made square holes. The Sturdy Square Holed Sleeve consists of a round sleeve with a perfectly square hole broached through the center. This hole is tapped at one end to receive a back-up screw which is furnished with the Sleeve. The Sleeve can be sweated or pressed into a drilled and reamed hole to make a perfectly square accurate hole in a very few minutes.



The Sturdy Square Holed Sleeve will save you many hours and many dollars in the making of boring bars, tool holders and other tools requiring square holes.

BUSHINGS MADE IN FOLLOWING SIZES:
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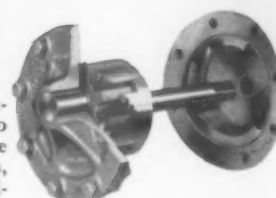
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Stripped PUMPS



Tuthill Stripped pumps are designed to be built directly into the machine. This saves space and material, reduces costs, and enhances appearance—advantages that are more important today than ever.

Two types are available — Model S, without supporting bracket; Model SA, with pumping elements only.

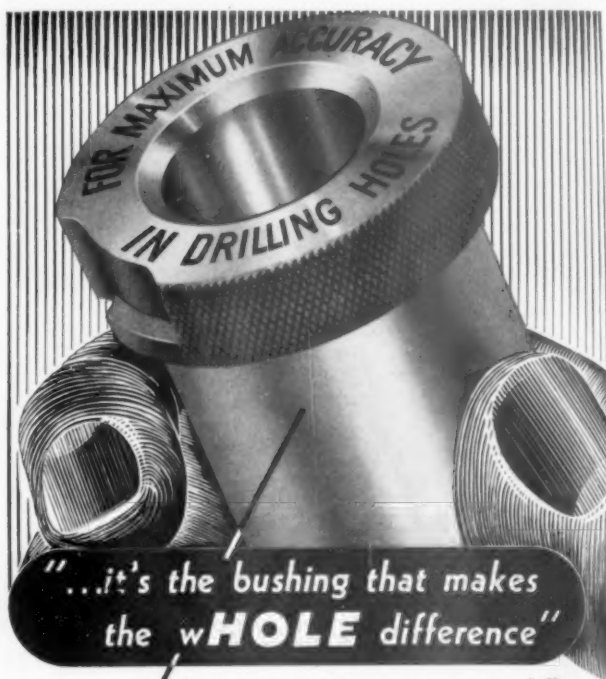
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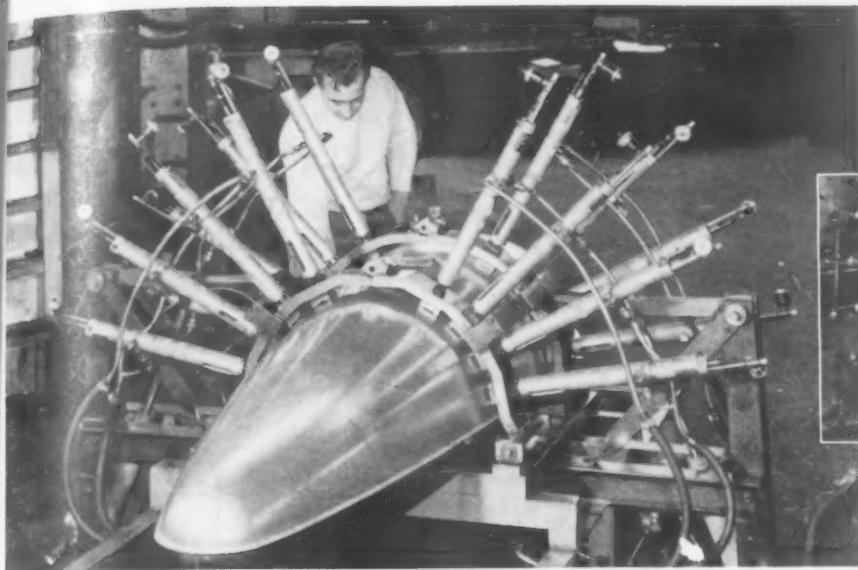
To maintain maximum accuracy in drilling operations, use the bushing that's precision made for the job...use Acme. Write for catalog.

Acme Industrial Company

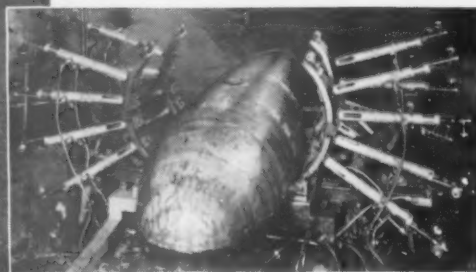
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THE SERVICE SHOP TO INDUSTRY FOR MORE THAN 25 YEARS

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With drills in operating position, the drilling cycle is ready to begin



Here the drilling fixture has been opened (by air cylinders) and the shell removed, showing the template below. Seen from opposite end

Now 1 man instead of 4 to drill these sixteen holes

North American Industries of Chicago manufactures gas tanks—the kind made to be jettisoned from aircraft. In producing them, sixteen accurately-spaced holes must be drilled in 14-gauge (.064) aluminum alloy, for mounting baffles in the teardrop-shaped shell.

Above is shown a fixture with sixteen Keller Airfeed-drills* which are now used for this drilling job. All sixteen drills operate simultaneously at the touch of an air valve—advance, drill, retract, and shut off. The entire cycle takes only 23 seconds—about half the time formerly re-

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Use of the new drilling setup has so speeded the flow of production at this point that stacking and rehandling the shells is no longer necessary. Elimination of the ragged breakthrough from hand drilling also simplifies deburring.

Perhaps you, too, have an application for Keller Airfeed-drills. We will gladly discuss it with you. In the meantime, write for our free booklet—"The Hole Story of the Keller Airfeedrill."

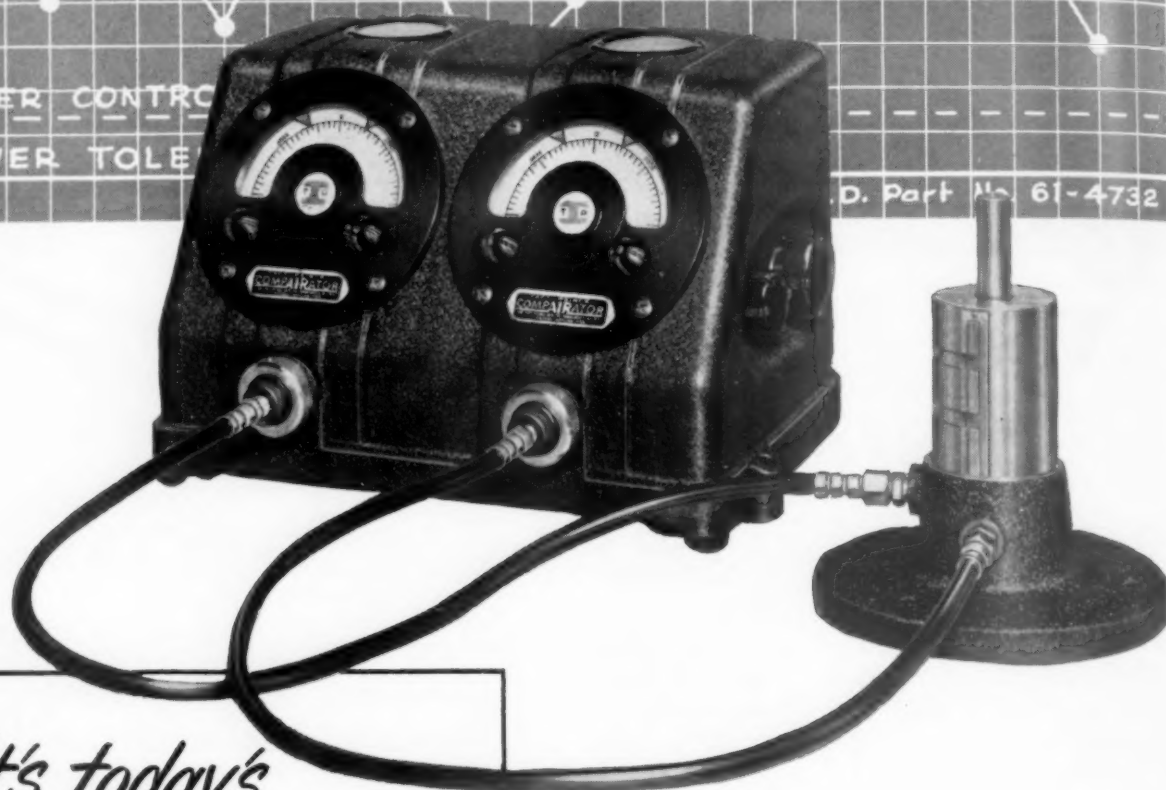
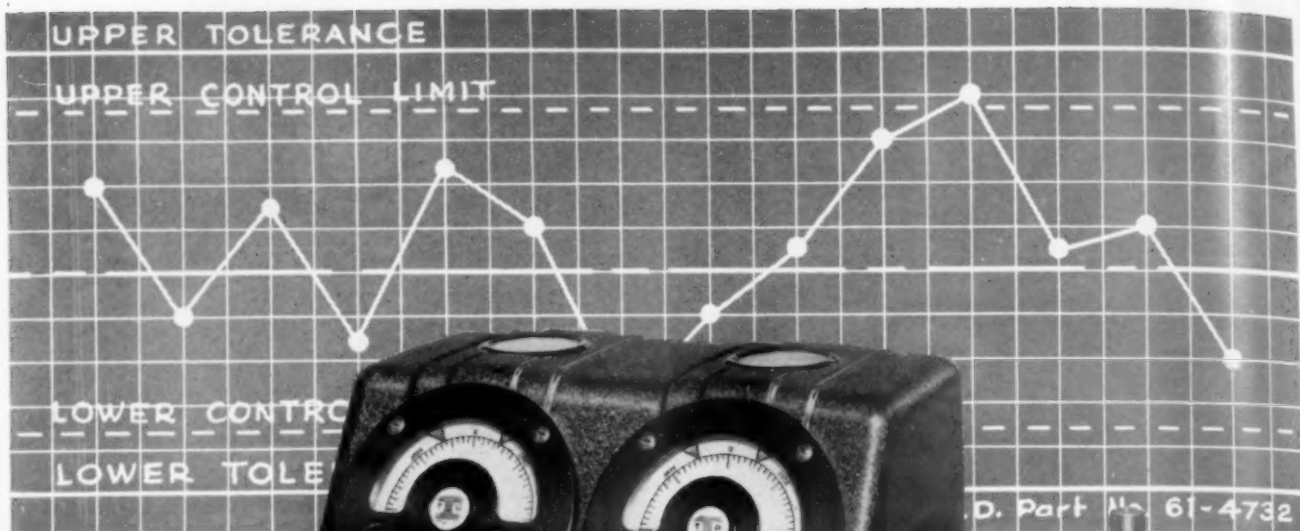
*Keller Tool Company Trade Mark



Features

of the Keller Airfeedrill*

- Assures accurate holes without costly fixtures . . . can be used with existing jigs
- Attaches in any position and supports itself at any angle
- Operates and is controlled entirely by air . . . with pneumatic cycling to speed production, reduce operator fatigue
- Small size permits it to be used on close centers and in tight places
- Accurately drills parts too large for conventional drilling machinery
- Wide range of speeds and strokes will accommodate light or heavy metal, wood, composition, plastic
- Lightweight portable and stationary models are readily adapted to changing job requirements . . . quickly shifted from job to job



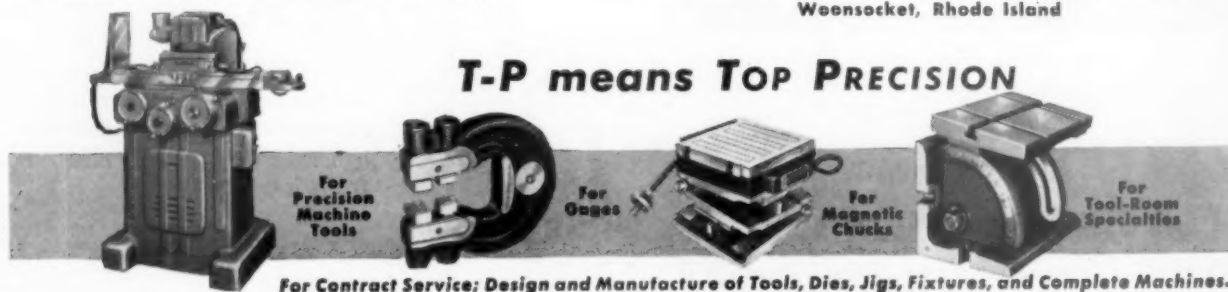
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Quality Control Tool
—the Taft-Peirce CompAIRator*

For economical use of Statistical Quality Control, the ideal gage is a versatile one—a gage suited to *trouble-shooting* as well as to permanent installations. The Taft-Peirce CompAIRator *is* that gage!

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These new, improved Firthite standard grades are superior in many respects to the more costly "special" grades formerly required. Better performance goes hand-in-hand with carbide tool standardization.



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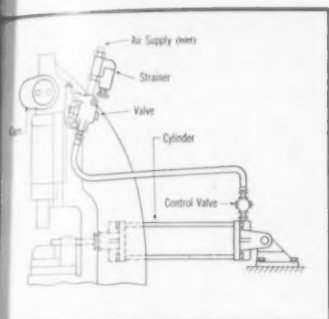
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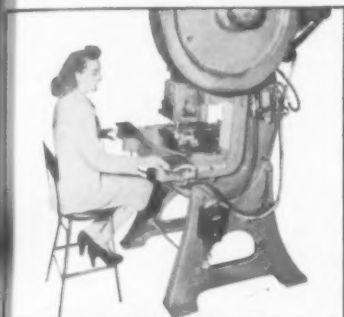


SPECIALTY TOOL • ALLOY • AND • STAINLESS STEELS

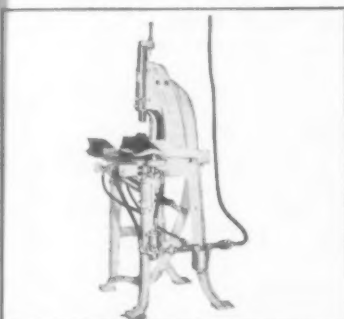
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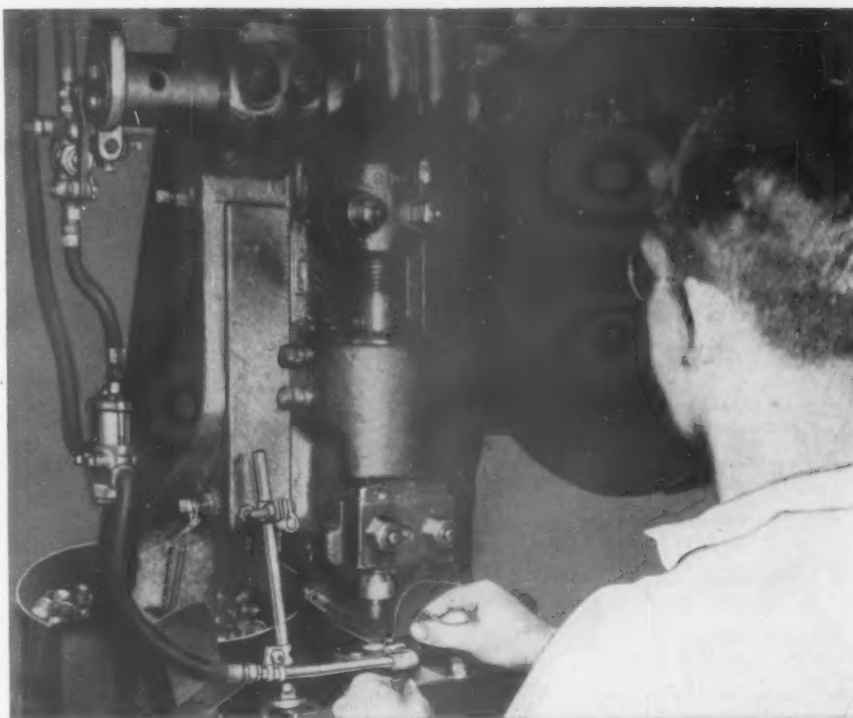
Schrader Power Press Controls—are one of the easiest ways to keep hands out of danger zones. Requires the use of two hands to operate the levers. Builds an operator-confidence that increases the flow of production.



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Sets. Before you decide your compressors have reached their maximum capacity investigate how Schrader Controls cut down air waste.

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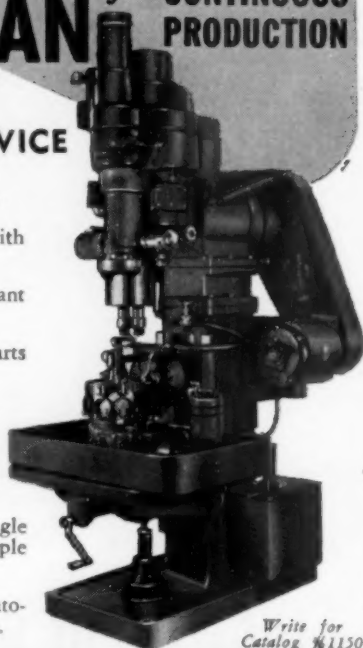
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STOPS LOSSES

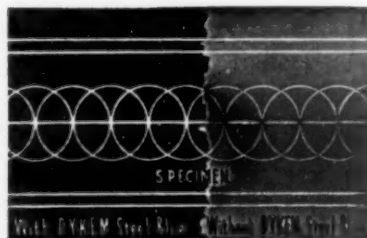
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& templates

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It saves money; frequently eliminating separate pickling operations on moderately rusty steel.

FREE For more information on Oakite Compound No. 33 write to Oakite Products, Inc., 18H Thames St., New York 6, N. Y.

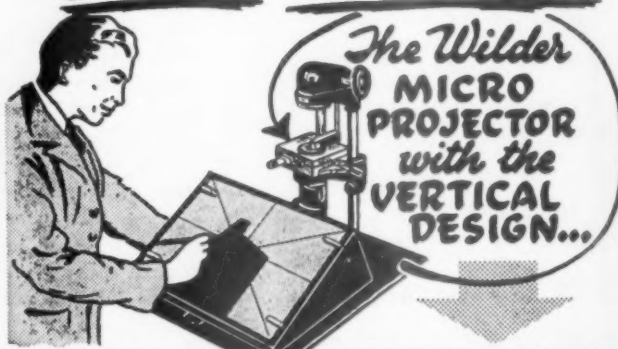
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Years before the Joint Industry Conference (J. I. C.) Standards for specifying "quality" hydraulic equipment were adopted, the *standard* design and construction features of Miller High Pressure Hydraulic (2000-3500 psi) Cylinders already included ALL the specifications for cylinders, seals and pistons now called for by the "Standards". Hard chrome plated, scratch-resistant piston rods and dirt wipers have long been standard Miller cylinder features yet are required by the "Standards" only under severe conditions.

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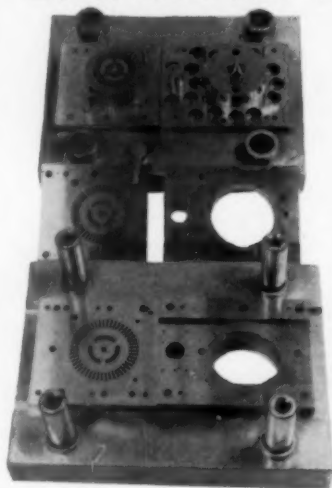
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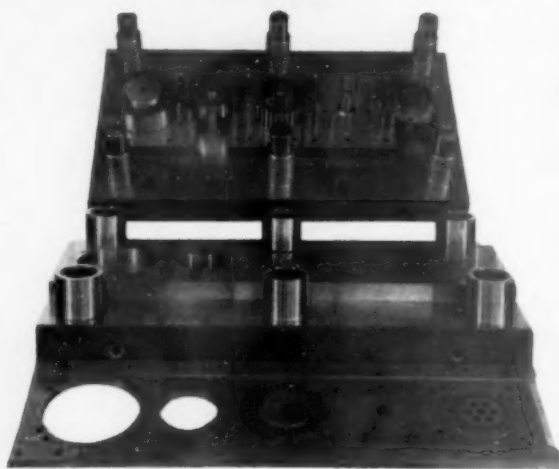
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March, 1951

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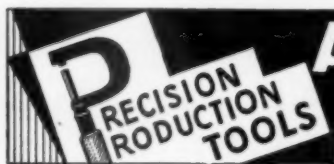
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ACME COMBINATION PIPE AND BENCH VISES
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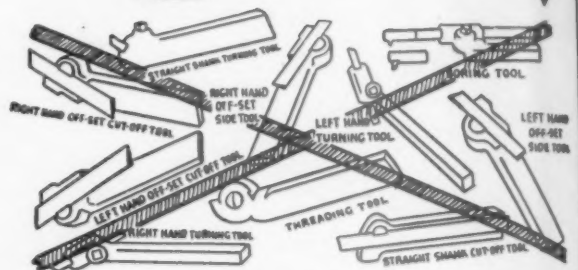
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Special S & E Solid Tungsten Carbide Drill Bushings are also available.

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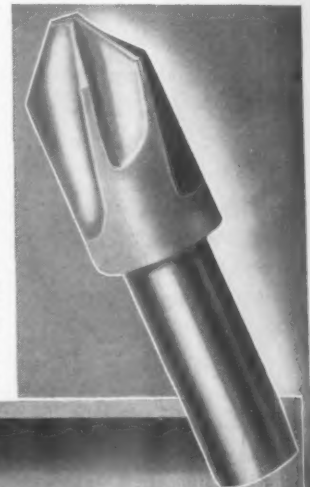
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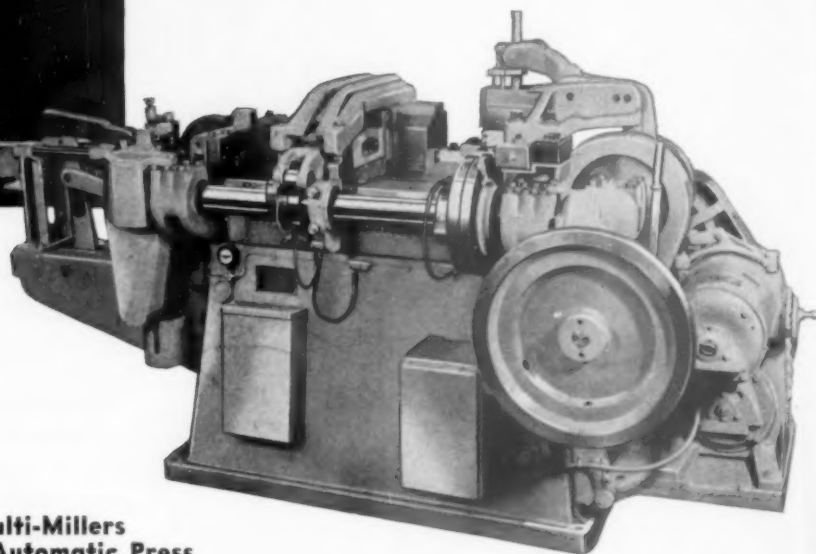
In the production of precision formed stampings from coil stock, the U. S. Multi-Slide can effect substantial savings, because it completes a finished part at each stroke of the machine. Many different types of parts which would ordinarily require costly secondary operations can be profitably produced—uniformly and to close tolerances—and the number of inspections also reduced.

The illustration shows the No. 33 U. S. Multi-Slide with some typical parts produced complete on the machine. The No. 33 has a capacity for material up to 2½" wide.

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Shown above actual size are some typical parts produced complete in one stroke on the No. 33 U. S. Multi-Slide Machine. Production rates are (top to bottom): Contact Support, 100 per minute; B-X Connector, 90 per minute; Contractor, 100 per minute; Typewriter Part, 125 per minute.



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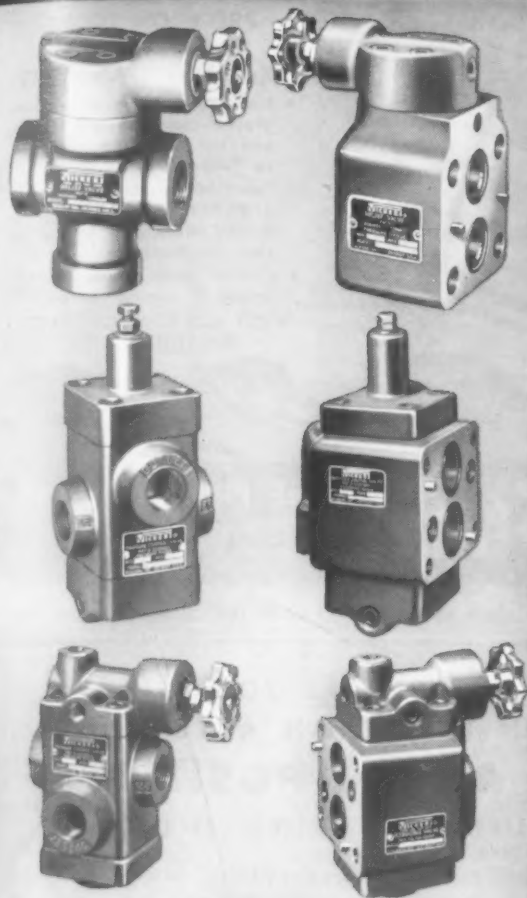


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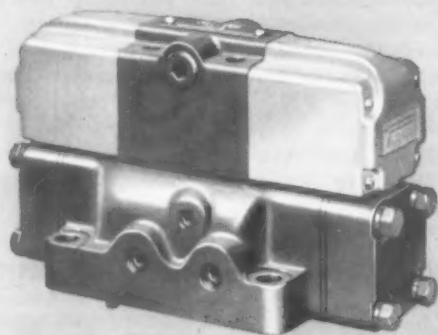
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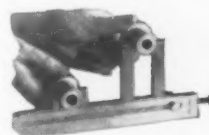
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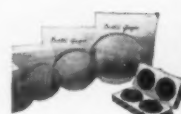
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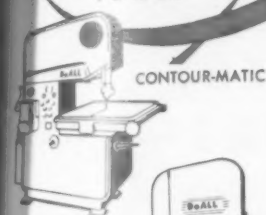
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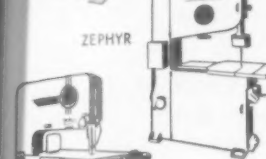
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Dial Indicators



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ZEPHYR



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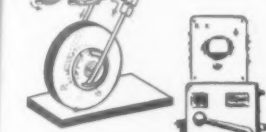
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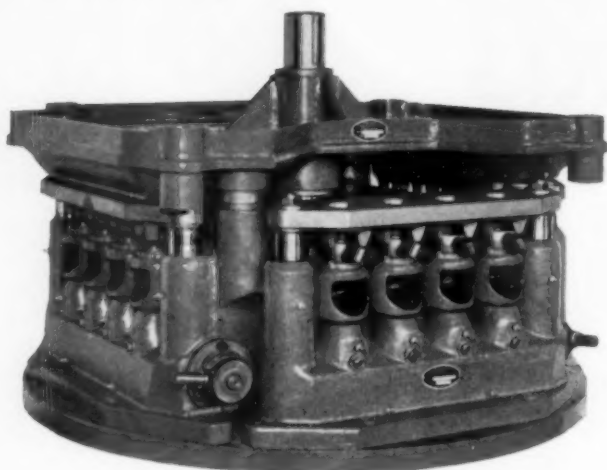


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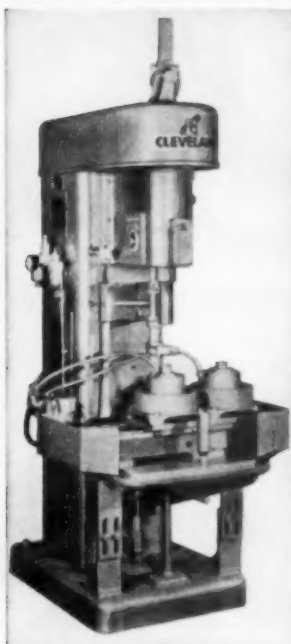
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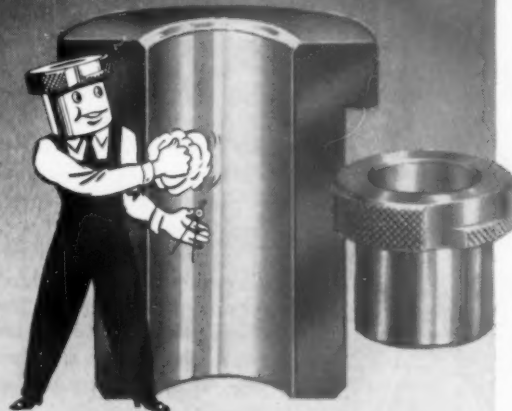
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
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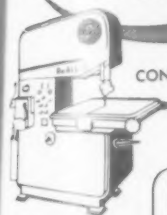
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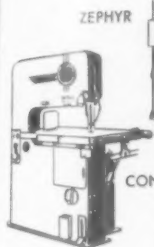
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The Tool Engineer

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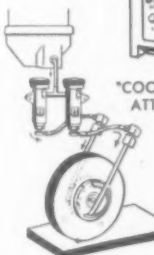
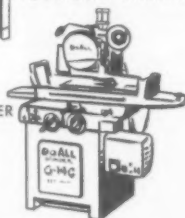


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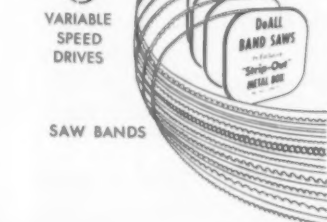
GAGE BLOCKS



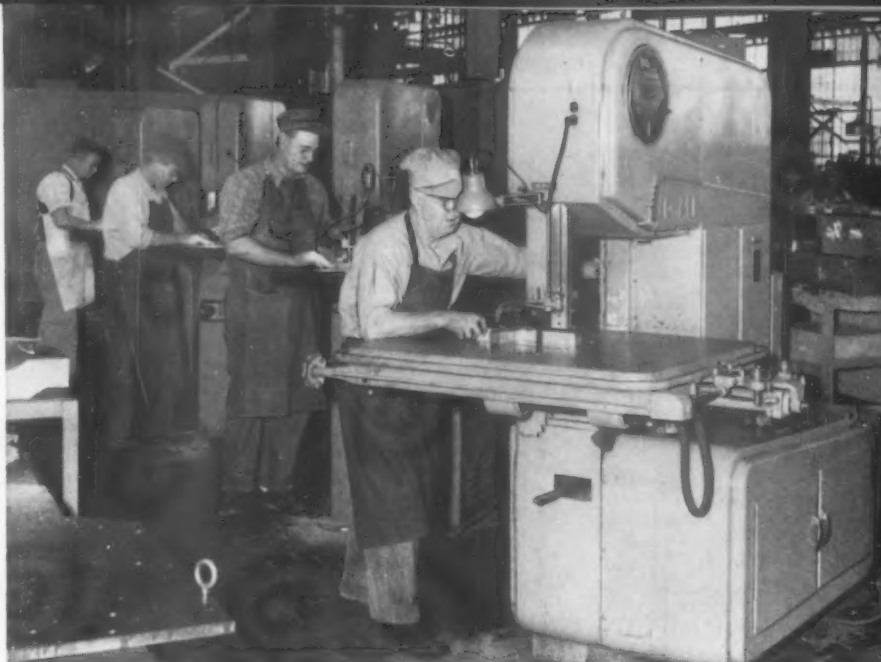
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FOR SCREW MACHINE PRODUCTION

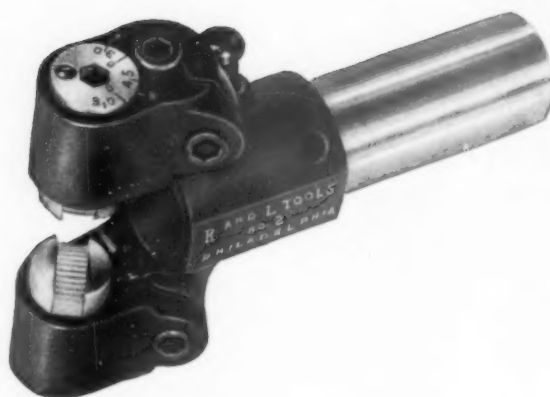


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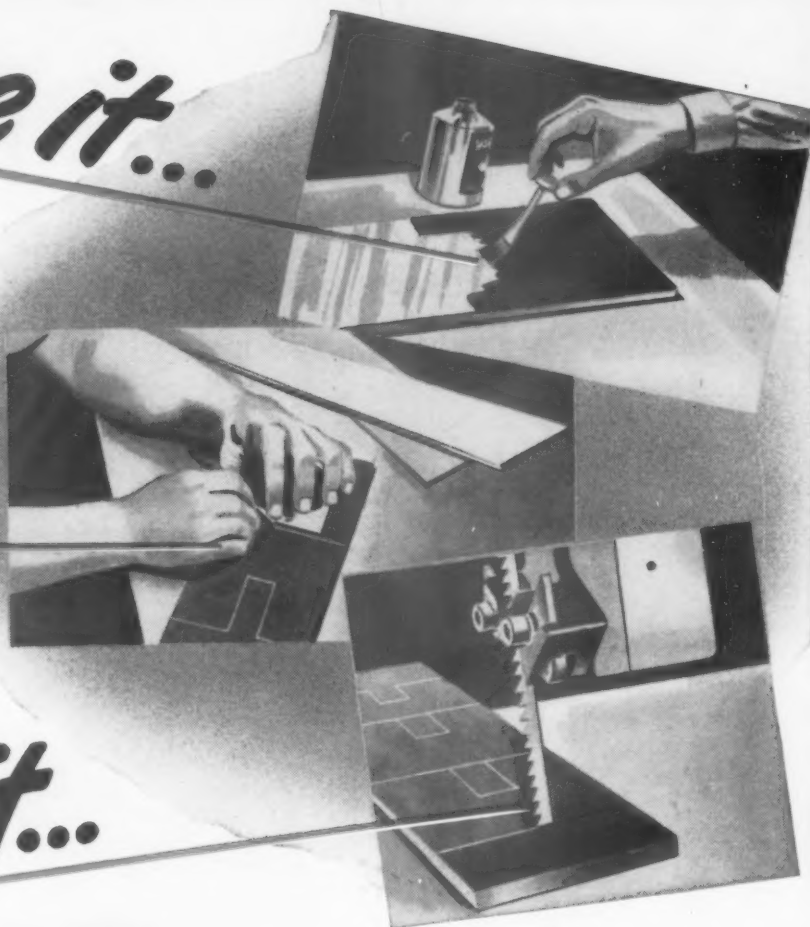
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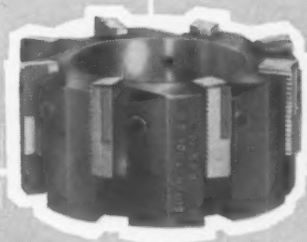
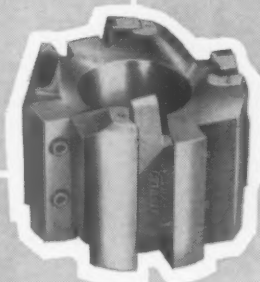
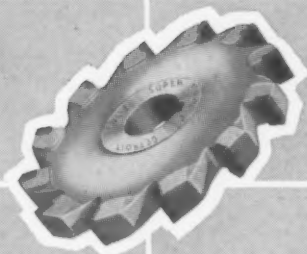
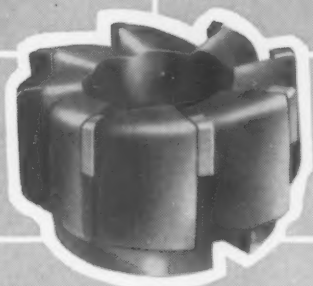
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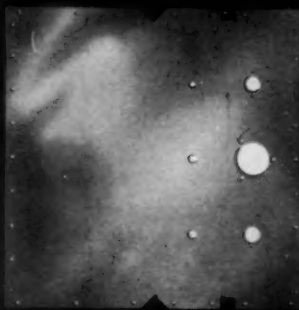


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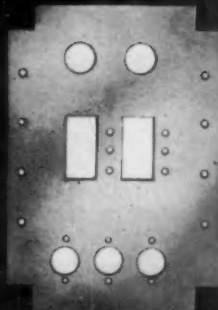


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INCLUDING SET-UP

10.10 MIN.

TIME FOR EACH
ADDITIONAL PIECE

3.25 MIN.



TIME FOR FIRST PIECE,
INCLUDING SET-UP

8.55 MIN.

TIME FOR EACH
ADDITIONAL PIECE

2.75 MIN.

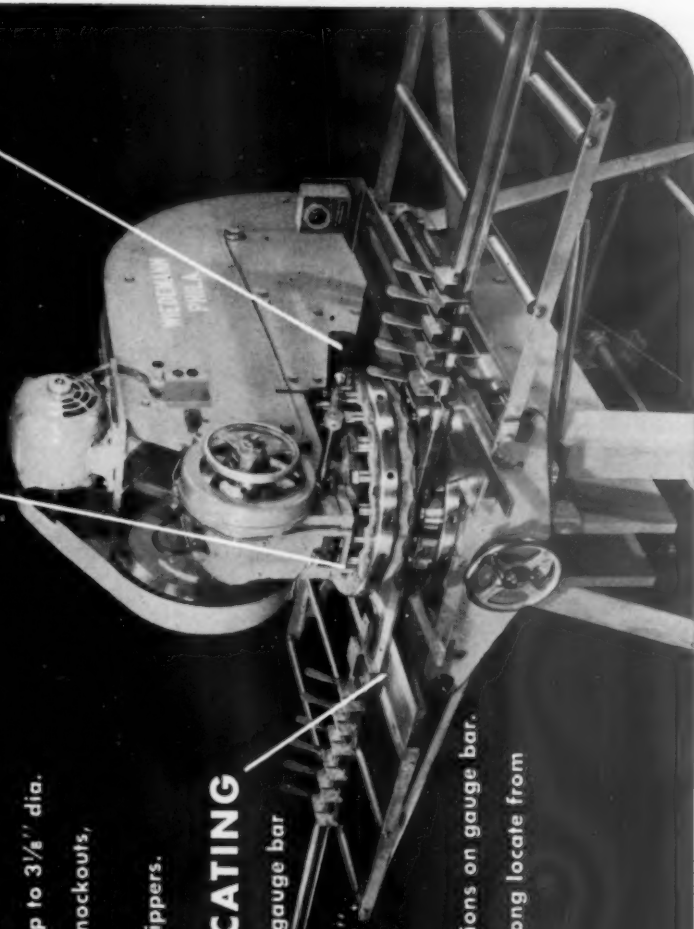
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- Standard and special tools—louvres, knockouts, extrusions, etc.
- Positive stripping action—no spring strippers.

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- "In and out" locations against rugged gauge bar (handwheel controlled).
- Dial shows "in and out" position in 1/4".
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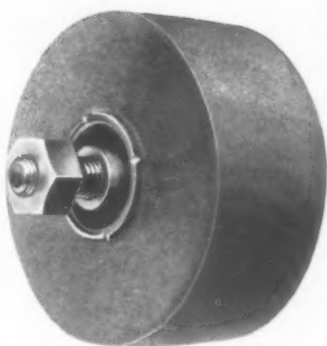
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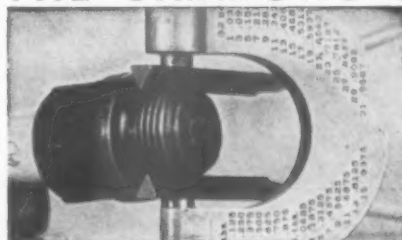
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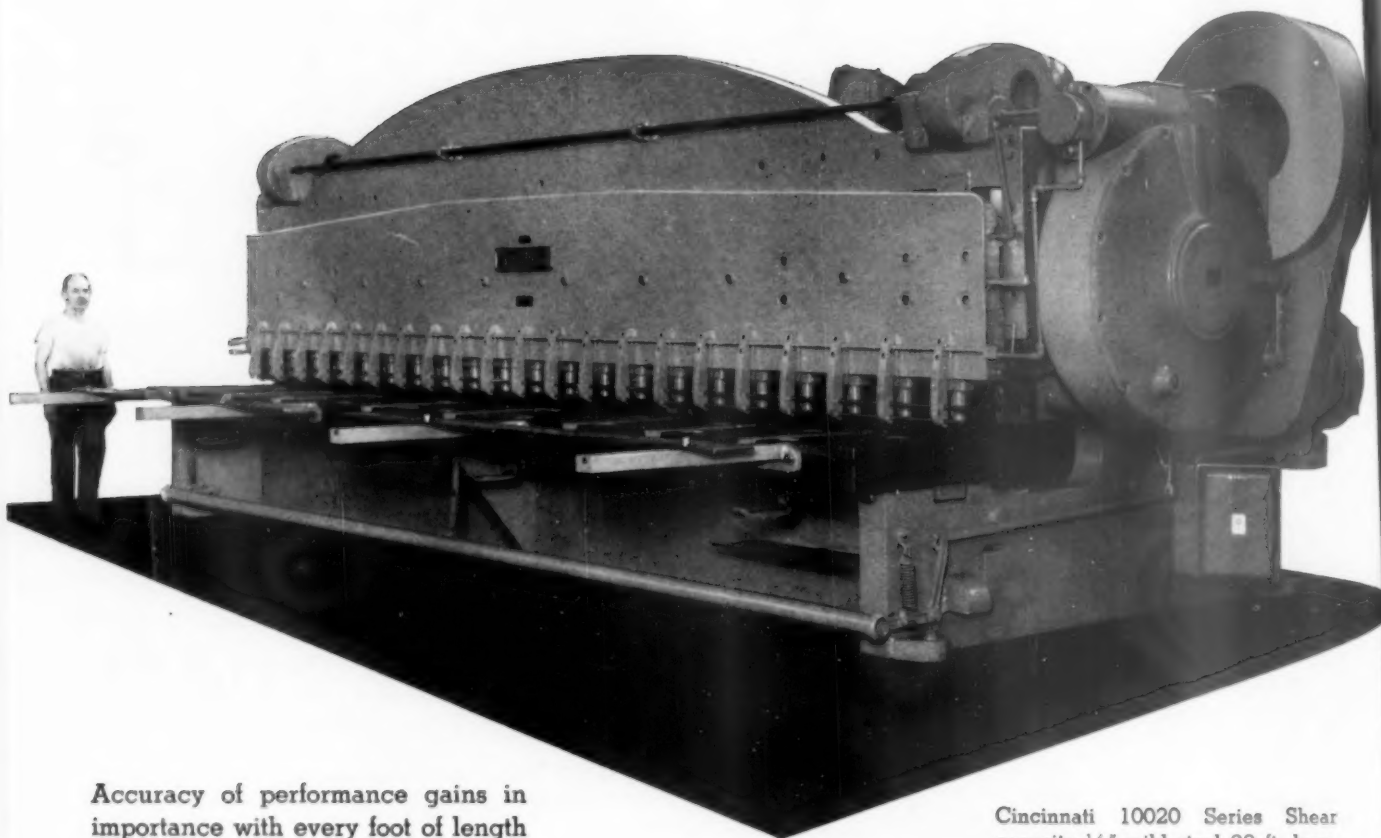
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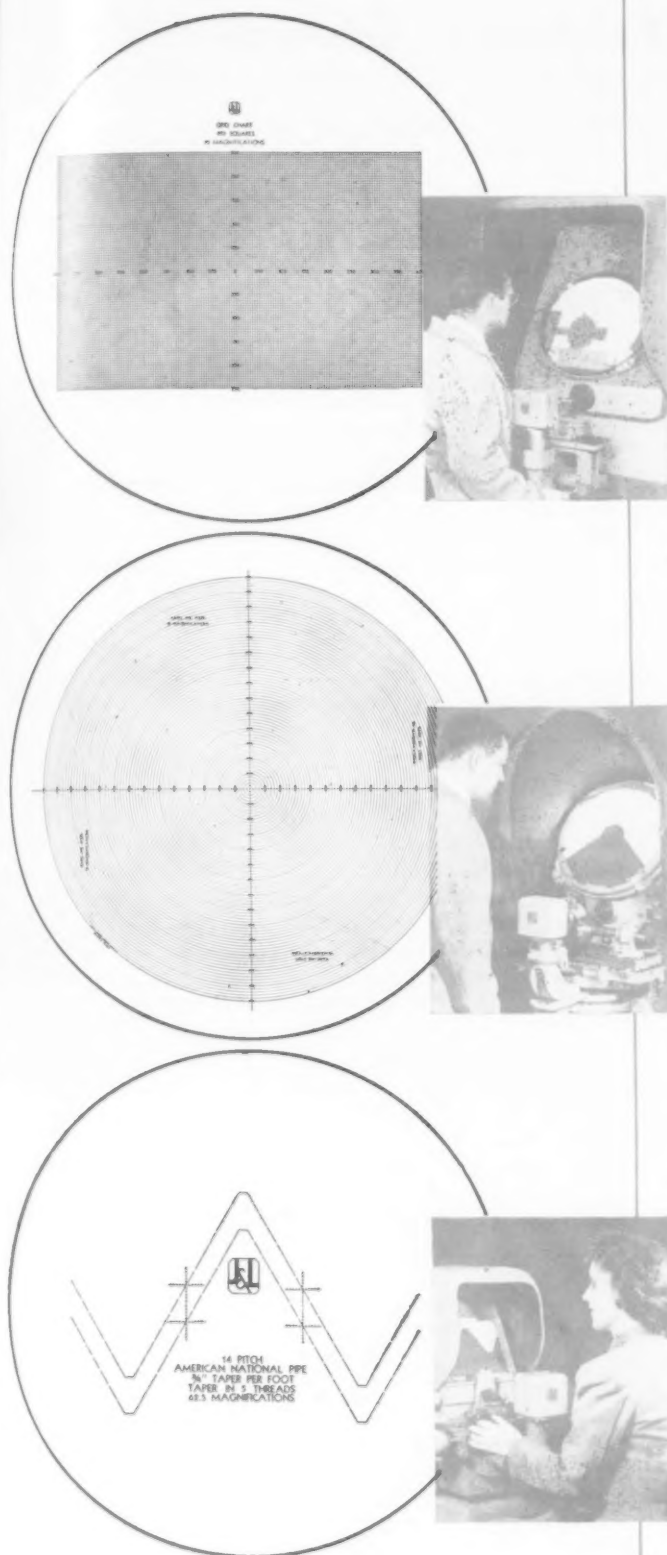
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MARCH, 1951

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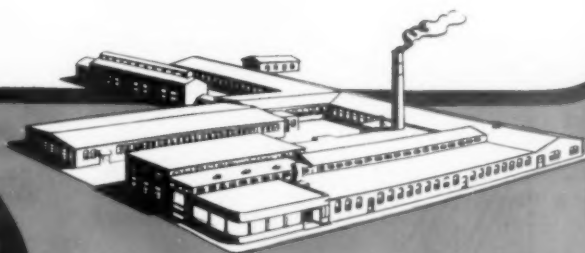
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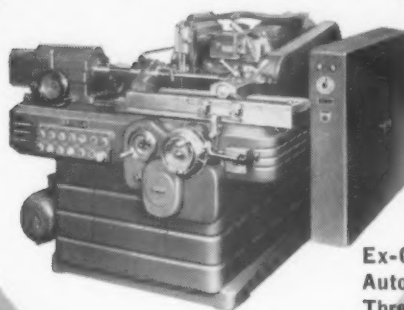
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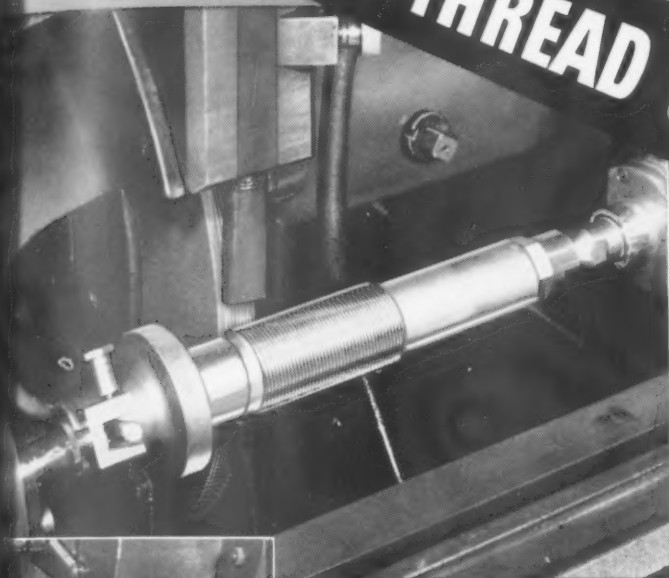
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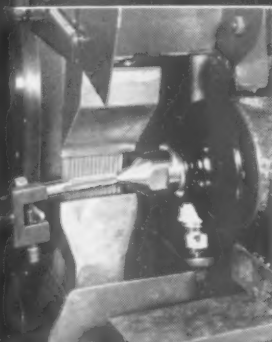
AUTOMATIC THREAD GRINDER



Ex-Cell-O Style 33 Automatic Precision Thread Grinder for external threads. Standard models for internal threads and universal models for both internal and external threads also are made by Ex-Cell-O.

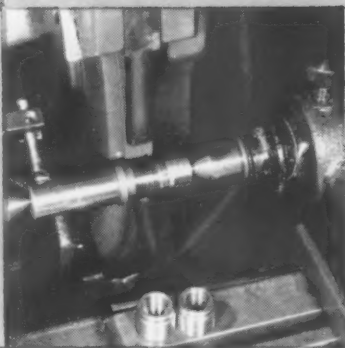


Grinding threads on cast-iron part with diamond dressed multiple-rib wheel on a Style No. 33 Grinder.



Skip-tooth diamond dressed multiple-rib wheel (wheel form is twice pitch of thread) grinding a $\frac{3}{8}$ "-18 tap.

Threading stainless steel aircraft bushings on an Ex-Cell-O Style 33 Automatic Thread Grinder.



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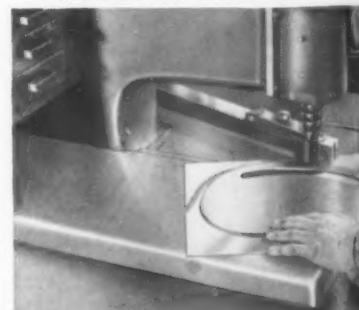
How the
WALES
SHEET METAL
Fabricator

✓ PUNCHES
✓ NOTCHES
✓ NIBBLES

Faster



Illustrating a Wales Type "NG" Notching in operation in the Wales Fabricator, notched corner in the work.



Showing the Wales Fabricator nibbling at the outside of the guide plate. Inside nibbling is accomplished in the same manner.

**Can you
match this
Time Study?**



This part, 22 1/2" x 9 1/2", with 4 holes and 2 sides notched and nibbled inside was produced in only 5.1 minutes.

G

PUBI